THE

ELECTRICAL REVIEW.

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"ELECTRICAL REVIEW."

Vol. LIII.] CONTENTS: October 30, 1903. [No. 1,353.

	Page
The Accidents on the L. & Y. Railway	685
Our Portrait Plates...	687
Alternating Current Generators at Preston (*illus.*)	688
The Ramsgate Tramcar Accident	690
Some Notes on Steam Turbo-Electric Generating Plants ...	691
Standard Direct Current Pressures and Standard Frequencies	694
Manchester Corporation and its Electrical Engineer	694
Devices and Fittings for the Current Electric Lighting Season (*illustrated*) (*continued*)	695
Legal	697
Correspondence	698
Business Notes	701
Electricity Supply Accounts	710
City Notes	711
Stocks and Shares	712
Share List of Electrical Companies	713
Market Quotations	714
Electric Tramway and Railway Traffic Receipts..	714
The Glasgow Municipal Telephone System—III.	715
Engine and Dynamo Breakdowns (*illus.*)	717
Tests of the Edison Storage Battery (*illus.*)	718
Gas-Pipe *v.* Copper	719
Failure of Electric Supply	720
Practical Examples with the Calculator Board (*illus.*) (*cont.*)	721
The Harison Patent Automatic Signal (*illus.*)	723
New Patents Applied For...	724
Published Specifications	724

THE

UNIVERSAL ELECTRICAL DIRECTORY

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THE ACCIDENTS ON THE L. & Y. RAILWAY.

THE occurrence of three serious accidents in one week in one district of the Lancashire and Yorkshire Railway Co.'s system, involving loss of life, personal injury, and serious damage to property, is another instance to show that however safe, comparatively speaking, railway travelling is in this country, we are not altogether immune from danger.

These occurrences will, no doubt, be the subjects of inquiry in the ordinary way, and the usual reports of the inspecting officers may be looked for in due course, when blame for neglect will doubtless be apportioned. It would be altogether improper to criticise these occurrences at this stage, before a full investigation has been made, but it is not out of order to point out that, under the rules for the signalling of railways, the combinations of traffic which have resulted in the disasters are not allowable, and that railway companies provide, at great expense, apparatus which is intended to afford all the information necessary to prevent disasters of the character under consideration.

It must also be remembered that the system of signalling in use on railways is one prescribed by an Act of Parliament, which conferred on the Board of Trade power to compel railway companies to provide certain apparatus to ensure the safety of traffic; and that the requirements of that Department of State in connection with the Act have now been formulated for some 11 years. It may be said at once that the requirements are not necessarily of an onerous character, and that railway companies, generally, have not required the stimulus of compulsion, which from the passing of the Act, would seem to have been necessary, to make their lines as safe as possible.

To those who have given attention to the subject the causes of similar accidents to the above are obvious. The system of working is perfect—so long as it is carried out in accordance with the rules laid down; and the apparatus provided is adequate—so long as it is duly worked and observed. It is the human factor that has, in the great majority of cases, been found wanting in the application of the system. Human ingenuity can design and draw up rules and regulations which can plainly direct the executive under all the multifarious conditions of railway working, and so dove-tail them that there is no weak place in the composition apparent from inspection. But human fallibility has on scores of occasions rendered all the careful preliminary work of no avail, and the results have been followed with the usual tediously detailed reports of investigations—the results of which could be foretold before the inquiries commenced—and the usual local recommendations.

Of what ultimate use are the reports and recommendations, of which there have been such large numbers? Do they in the slightest degree diminish the number of accidents? If so, how do we find accidents of the same character continually recurring; varying only, in their main cause, in the

majority of cases, from neglect on the part of drivers to neglect on the part of signalmen? Is not the trouble too deeply seated to be affected by local recommendations? Are the requirements formulated by the Board of Trade in 1892 so full as to meet the conditions which are found to be the causes of the great majority of accidents on railways? Are the requirements drawn up as clearly and intelligently as they might be, or even as fully as the regulations of the companies working to these requirements; or have they been drawn up with so great a regard to the fetish of independent initiative, individuality, and want of common action that has been so great a characteristic of this country for the last half century, as to render them ineffective?

Consider the requirements of the Board of Trade under the Act of 1889 for the mechanical interlocking of points and signal levers, and contrast them with those dealing with the electrical equipment. Could any contrast be greater? In one case we have the most precise details of the results to be obtained; in the other the vaguest possible statement under a heading which is not applicable. Of the interdependence between the various portions of the whole equipment for signalling there is not the faintest recognition in the requirements. For all the evidence the regulations afford, they might as easily have been drawn up by "the man in the street" as by those having expert knowledge of the conditions to be met; and yet these requirements were not formulated in advance of the application of the system, but followed its introduction at such a respectable interval of time as should have afforded ample opportunities to ascertain previously unrecognised weaknesses, or defects, from actual working.

All this, of course, goes to show that the Board of Trade follows, where, from its claims to be the guardian of the public, it should lead, and notwithstanding the innumerable reports embodying the weak points of the system which have been submitted by its inspecting officers, it shows no signs of any intention to amend its requirements.

If supervision of the working of railways is necessary in the interests of the traveller, it should be effective, or it will degenerate into an expensive farce. At present the results obtained are of a negative character, and it would be better to leave the companies to their own devices than to interfere in a non-effective fashion—to investigate in order to apportion blame, or to make suggestions that are obvious to everyone *after* the occurrence. The railway companies themselves are alive to the fact that beyond the destruction of property, and the expenses of compensation which serious accidents involve, the traffic of a line with a bad reputation will inevitably suffer, and they know that it is to their own interests to keep the public mind in equanimity on this point. For this reason further suggestions by the Board of Trade, to meet what are undoubtedly weak points in the general system of signalling, would not meet with so great a resistance from the railway companies as might otherwise be expected. The present attitude of the Board of Trade, however, indicates too great a fear of the responsibility to be incurred from definite recommendations.

Municipal Telephony.

In this issue we publish the concluding article of a series to which a detailed analysis of the recently published accounts of the Glasgow Corporation telephone department has given rise. In view of the figures that result from a proper comparison of the accounts and the statistics of the plant, the complacency with which the outcome of the Glasgow telephone venture is regarded by the majority of the Telephone Committee, and of the Town Council itself, is truly remarkable. It seems hardly credible that the members of the Telephone Committee can be so very uninformed as to the real status of the enterprise as they appear to be from the Town Council discussions. It is comprehensible that the Council, as a body, should fail to appreciate the difference between "instruments" and subscribers' lines, and its bearing on the accounts; but what is excusable in the general gathering of the Council is quite otherwise in the Committee having direct charge of the system. If any attention is paid to the periodical reports and statistics which it is the duty of such a Committee to receive and examine, the distinction between lines and instruments is bound to reveal itself.

As we have shown, it is by citing the total number of instruments of all kinds in such a way as to give the impression that the actual number of subscribers was meant, that such an exaggerated idea of the progress of the Glasgow Corporation telephone system is afloat. By this means, too, the great difference between the actual capital cost and the estimated cost has been kept in the background. This difference amounts to over £88,000. That is, on the basis of the estimate on which the work was undertaken, the 7,441 subscribers' lines existing at May 31st, 1903, should have cost a total of £171,515. The actual cost was £259,744, or an excess of £88,229 (more than 50 per cent.) over the estimated cost. The figures can hardly have revealed themselves in this guise to the Glasgow Telephone Committee, or their defiant attitude toward all sensible criticism would necessarily have lacked something of its stolidity. But now that the facts have been put in their true light, we shall be curious to see if "success" will be proclaimed with the same pawky air of Scotch superiority as heretofore.

Even though a mistake of large dimensions had been made in estimating the cost of establishing the business, the Glasgow Corporation might still be able to claim a sort of *succès d'estime* had they been able to show conclusively that they were able to operate it as cheaply as was estimated. But the accounts do not show this at all conclusively. A "surplus" of under £1,700 is screwed out of a full year's working by dint of omitting depreciation entirely, and of charging to capital expenditure much that should properly be charged to expense. A careful consideration of these omissions indicates that the accounts, instead of yielding a credit balance of £1,700, should show a deficit of over £21,000. The omission of depreciation was but to be expected, as the alternative would have been to show a heavy loss; yet the most elementary prudence would dictate, in face of the terms of the licence and of the obsolete character of the telephone plant which Glasgow has chosen to construct, a depreciation fund on most liberal lines. As to the charging of expense to capital account, it is not clear from the accounts to what amount this has been done, but there is *primâ facie* evidence that it has been done to a considerable extent. Indeed, the high capital cost of the system is partly accounted for in this way, as every device has been resorted to in order to secure cheapness, yet the plant comes out at about the price of a really modern system.

As a matter of plain common-sense fact, the Glasgow Corporation is engaged, as far as its telephone system is concerned, in an attempt to do the impossible; or, at all events, the unprofitable. It is selling for 10s. what costs at least 16s. to produce. No system of book-keeping, no manipulation of figures, no amount of rhetoric and argument at Council meetings can alter the real facts, or for long prevent

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them from becoming thoroughly well known. As Lincoln said, "You may fool all of the people some of the time, you may fool some of the people all of the time, but you can't fool all of the people all of the time." The sooner the Glasgow Corporation recognises the force of this homely aphorism the better.

Unreasonable Demands.

A FRIEND has, during the past week, sent us for perusal a specification sent to him by a manufacturer, who evidently has accepted from a British municipal authority a contract containing the same clauses. The specification asks for the supply of three 15-H.P., one 10-H.P., and one 5-H P. direct-current motors, the necessary starting resistances, a portable drill, small power hammer, blowing fan and electrically-driven air compressor, and asks for detailed prices for each item. The terms of payment are 80 per cent. on delivery, and 20 per cent. six months after the machines are set to work. This may be an indefinite period, for the contractor only delivers the material on site, and there is no obligation on anyone to see that it is put to work. In giving prices, the contractor is asked what discount he can allow, as if the original trade allowance had not been swallowed up by the costs of packing and delivery, as well as the risks he must undertake under the contract. Disputes are to be subject to the final decision of the general manager of the corporation which issues the specification, whose awards may be made legally binding on the application of either of the parties. The contractor may not sublet without distinctly giving all particulars in his tender, or being subject to a fine of *£100*. He must pay Trade Union rates, or those agreed on as equivalent thereto by Trade Unions and employers; must either deliver by contract date under pain of instant cancellation of the order, or withhold delivery for an indefinite time without extra charge; and, as a last resort, be liable for any demands which may be made by His Majesty's Factory Inspector. Seeing that the contractor is not consulted on this matter, it is surely unfair to place any such liability on his shoulders. The conditions are hardly creditable to the Corporation responsible for their issue, and we thoroughly approve of our friend's decision not to tender to any such unfair conditions.

Vexatious Litigation.

THE result of the appeal in the action Wilde *v.* Thompson, which is reported elsewhere in our pages, will be welcomed by every lover of freedom and justice in technical literature. So little importance was attached to the contentions of the appellant that Dr. Thompson's counsel was not even called upon to reply to them. It is to be regretted, however, that, in spite of the unsuccessful result of this and similar actions, the winner gains a Pyrrhic victory, for, even when the assailant is ordered to pay the costs of the action, the object of his attack is put to very great expense, inconvenience and worry. Not only so, but serious misstatements may be put forward, which, if unchallenged, may produce totally wrong impressions upon the public mind. For example, in the present instance, it was stated by the appellant's counsel that the former enjoyed the universal reputation of being the inventor of the dynamo; needless to say to a technical audience, that the immortal Faraday, the father of electrical engineering, clearly enunciated the fundamental principles upon which the dynamo is based. Moreover, not only did Faraday use steel magnets, but also electro-magnets in these researches, thereby completely anticipating his successors in this subject. We willingly accord to Dr. Wilde the honour which is undoubtedly his due, of having made great improvements in the practical construction and applications of dynamo-electric machines; but we decline to add to his fame at the expense of that of Michael Faraday—to say nothing of the many other inventors who bore a large share in the evolution of the modern dynamo-electric generator.

OUR PORTRAIT PLATES.

WITH this issue of the ELECTRICAL REVIEW our readers will receive a special supplement comprising portraits of 200 chief engineers of electricity works of the United Kingdom; a greater number would have been included, had it been possible, but it was only when we had commenced the collection of photographs for the purpose that we realised the exceeding modesty of our station friends. Some pleaded their unwillingness to appear in so public a manner. Others were unprovided with photographic portraits of themselves; whether the deficiency was due to the excessive demand for such on the part of their feminine acquaintances, or to other causes, was not usually stated. One engineer stated that he had not been photographed since he was five years old, and he did not suppose his portrait at that age would be of interest to our readers; but we are disposed to think that, on the contrary, they would have been keenly interested! Another, in forwarding his photograph, remarked that he would be glad to see all his brother engineers hanging in his office—but kindly added, in portrait form!

The photographs commenced arriving in June, and were still coming in up to the middle of September. We offer our thanks to all who have favoured us with their assistance, and our regret that we have been obliged to keep them waiting so long. While the utmost care has been taken in order to append the correct name to every portrait, so many photographs came to hand without either name or address attached, that we frequently experienced great difficulty in their identification; we sincerely trust that our efforts to ensure accuracy will be found successful.

No attempt whatever has been made to classify the portraits: we therefore append an alphabetical index, giving after each name the number of the plate, followed by that of the line in which the corresponding portrait will be found.

Acland, R. L. (I. 2)
Appelbee, N. (I. 5)
Atchison, C. C. (II. 4)
Bache, W. J. (I. 6)
Banister, A. N. (I. 2)
Barber, A. E. (II. 2)
Batty, F. R. (I. 6)
Bell, J. A. (II. 1)
Bentley, C. W. (II. 2)
Bird, A. G. (I. 5)
Birkett, R. (I. 8)
Blackman, A. (II. 1)
Blaikie, J. R. (II. 9)
Blake, A. W. (II. 1)
Blascheck, C. A. (I. 2)
Bolton, W. F. (II. 2)
Boot, H. L. P. (II. 8)
Boyd, W. (II. 4)
Brandreth, W. E. (I. 7)
Britton, S. E. (I. 10)
Bruce, G. A. (II. 10)
Bryant, G. (I. 3)
Brydges, J. K. (I. 10)
Bulfin, I. (I. 4)
Burbridge, J. (II. 7)
Burnet, C. D. (I. 4)
Caldwell, H. C. (II. 10)
Campion, R. H. (II. 4)
Carter, G. H. (I. 8)
Carter, A. J. H. (II. 8)
Cawthra, J. H. (I. 9)
Chamen, W. A. (II. 10)
Charlton, G. (II. 9)
Chattock, R. A. (I. 3)
Christie, J. (I. 5)
Clarke, J. B. (II. 6)
Clegg, S. (II. 6)
Clothier, T. D. (II. 1)
Colebrooke, W. H. F. (I. 10)
Colson, A. (II. 9)
Cooke, W. H. (II. 3)
Cooper, A. T. (II. 1)
Cooper, A. G. (I. 9)
Cottam, G. H. (II. 8)
Cowell, C. A. (I. 10)
Crook, R. M. (I. 9)
Cross, E. (II. 6)
Crowther, J. P. (I. 8)
Davis, A. L. (II. 3)
Day, A. A. (I. 3)
Dickinson, H. (II. 2)
Dixon, H. (II. 9)
Dobson, S. T. (II. 8)
Downe, R. S. (I. 5)
Duesbury, T. (I. 8)
Edgcombe, J. E. (II. 6)
Ellis, A. (II. 3)
Ellis, J. E. (II. 6)
Endean, J. W. (I. 6)
Farrow, A. E. (I. 9)
Fedden, S. E. (II. 5)
Fell, A. L. C. (I. 1)
Foster, H. F. (I. 2)
Francis, F. H. (II. 5)
Francis, O. F. (I. 6)
French, A. H. (II. 9)
Fuller, A. J. (II. 3)
Gamlen, R. L. (II. 4)
Gay, A. (II. 3)
Gibson, S. C. (I. 3)
Gray, H. (I. 3)
Griffin, J. G. (II. 4)
Grimsdale, W. H. (I. 1)
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Jones, S. D. (I. 3)
Joyce, W. H. (I. 6)
Kennedy, Dr. A. B. W. (II. 7)
Kilgour, M. H. (II. 7)
King, L. H. (I. 4)
Kinghorn, D. M. (I. 1)
Knight, J. D. (I. 7)
Lambert, J. (I. 8)
Langford, W. (II. 8)
Lee, A. E. (II. 8)
Leech, S. G. (I. 10)
Leeming, W. J. (I. 7)
Le Rossignol, A. E. (I. 8)
Lironi, V. G. (I. 2)
Lunn, J. R. P. (I. 1)
M'Cowen, V. A. H. (II. 1)
McHaffie, H. G. (I. 1)
McInnes, C. F. (I. 6)
McLean, J. G. (II. 2)
McMahon, J. (I. 3)
McMahon, P. V. (II. 7)
Marshall, R. (I. 7)
Marshall-Harriss, G. (I. 5)
Maxwell, H. B. (II. 2)
Metzger, G. F. (I. 9)
Milns, W. E. (I. 5)
Milton, C. O. (I. 5)
Montgomery, C. R. (I. 5)
Munro, H. D. (II. 5)
Nalder, H. H. (I. 7)
Parkinson, C. F. (II. 2)
Partington, T. (I. 8)
Partridge, G. W. (II. 5)
Pay, F. C. (II. 6)
Pember, J. D. (I. 9)
Perry, J. (I. 4)
Pickersgill, A. (I. 9)
Pilcher, O. A. (I. 4)
Pilditch, G. F. (II. 4)
Pilling, J. (II. 7)
Pinkerton, H. W. (I. 9)
Poulton, F. G. (II. 9)
Proctor, H. Faraday (II. 9)
Raine, A. D. (II. 5)
Richardson, H. (II. 10)
Rider, J. H. (II. 6)
Ridley, E. (I. 1)
Robertson, J. A. (II. 5)
Robins, F. J. (II. 1)
Robinson, L. L. (II. 10)
Rogerson, W. M. (I. 2)
Russell, C. N. (II. 7)
Rutherford, A. P. (I. 2)
Rye, A. N. (II. 5)
Salter, J. R. (II. 8)
Salter, G. (I. 1)
Schofield, S. D. (II. 5)
Schultz, G. (II. 5)
Scott, J. G. (II. 3)
Seabrook, A. H. (II. 4)
Senior, J. (I. 4)
Shaw, A. H. (I. 7)
Shaw, J. (I. 10)
Sheardown, P. S. (II. 9)
Sillery, W. (I. 3)
Simpson, F. A. (II. 8)
Sisson, W. H. (I. 6)
Smith, C. B. (II. 2)
Smith, G. E. (I. 8)
Smith, J. J. (II. 6)
Smyth, J. M. (II. 1)
Smyth, M. G. (II. 10)
Snell, J. F. C. (II. 7)
Spenser-Yates, R. G. (I. 8)
Sprunt, H. W. (II. 10)
Staniland, N. (II. 3)
Stiven, E. B. (I. 2)
Storey, P. (II. 9)
Sutherland, C. J. (I. 6)
Taite, C. D. (I. 2)
Talbot, H. (I. 10)
Tapper, W. C. P. (II. 7)
Taylor, H. M. (I. 8)
Tester, W. A. (II. 2)
Thomas, H. N. (II. 8)
Thornhill, E. B. (II.
Tomlinson-Lee, H.
Tudman, A. R. (II. 6)
Turnbull, C. (II. 3)
Tweedy, R. N. (II. 8)
Tyson, T. (II. 6)
Ullmann, W. C. (I. 7)
Vandrey, J. C. (II. 3)
Vincent, W. H. (I. 10)
Waterland, A. J. C. (II. 10)
Watts, H. W. (I. 7)
Watts, P. J. (II. 10)
Warburton, H. N. (II. 10
Whieldon, A. W. (II. 5)
White, P. F. (II. 4)
Wilkes, A. (I. 5)
Wilkinson, F. A. (I. 3
Wilkinson, G. (I. 4)
Wyld, W. (II. 7)
Wyllie, A. (I. 4)

ALTERNATING CURRENT GENERATORS AT PRESTON.

The direct current type of generator which Messrs. Dick, Kerr & Co. have supplied to many of the lighting and tramway authorities in this country and abroad has been commonly accepted as one embodying the highest skill in design and success in manufacture.

With the rapid development of three-phase plant for lighting, railway and power work, it was natural that the great facilities which the Preston Works possess for the manufacture of the largest machines should be directed to this class of generator, and during the past 18 months some very important machines have been under construction.

For a long period it was a standing reproach to British enterprise that engineers of English tramway and lighting systems should be compelled to obtain their alternating machinery from abroad. Whatever may have been the reason for the stationary position of English manufacturers, there is now, except on a question of price, no longer any necessity for purchasers to go either to the Continent or to the United States. To whatever purpose the machines are to be applied, whether for transmission, for tramways, for railways, or for collieries and works, the requirements can be adequately met by home manufacturers.

Though starting comparatively late in the manufacture of polyphase machinery, English shops have not been entire losers, for, by a process of selection, they have been able to avoid many features of design which did not specially commend themselves to English engineers. In other words, it has been possible, by utilising the experience of foreign manufacturers, to adapt and adopt designs which are more suitable for home conditions, and in consequence therefore it may be claimed for English productions that they will be free from many of the objections inseparable from foreign made machines.

In addition to having carried out some important developments in alternating current practice, Messrs. Dick, Kerr and Co.'s works are engaged in manufacturing other special apparatus. High pressure switch-gear now ranks among their productions, and motors, direct current and alternating, for power purposes, with the necessary controlling mechanism, have become part of the standard machinery turned out at Preston. This extension into lighting and power work has necessitated some important additions to the works, a new bay some 450 ft. long and 60 ft. wide having been recently completed.

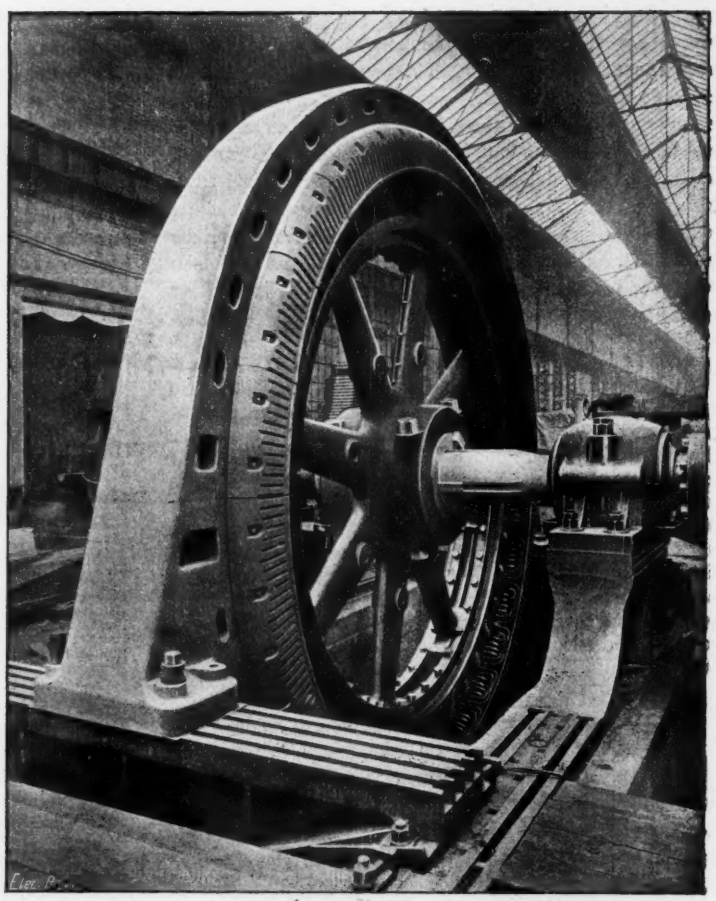
Among the orders for polyphase plant which Dick, Kerr & Co. are completing may be mentioned the following :—

London County Council	Two 1,500-kw. (alternating).
Ditto	Twelve motor-generators, each of 300 kw.
Ditto	Three " " 50 kw.
Horndean Tramways ...	Two motor-generators... each of 200 kw.
Portsmouth Corporation	Two motor-generators... each of 200 kw.
Sydney	One alternator ... ... 300 kw. Two alternators ... ... 600 kw. Six motor-alternators... ... ... 300 kw.
Stalybridge	Three alternators... ... each of 500 kw.
Malvern...	Two alternators ... ... each of 100 kw.
Fulham	One alternator ... ... 600 kw.
Osaka	One alternator ... ... 1,110 kw.
Durban	One alternator ... ... 500 kw.
Lakefield Portland Cement Co., Ontario.	One alternator ... ... 1,000 kw. One alternator ... ... 450 kw.
Shawinigan Water and Power Co. Montreal ...	One alternator ... ... 3,750 kw.
Metropolitan Electric Supply Corporation...	Eight motor-alternators, each of 500 kw.

And amongst others may be mentioned complete plant comprising generators and sub-station machinery for the Lancashire and Yorkshire Railway, Leeds and Wakefield Light Railway, and Tokio Electric Tramways.

In the design of polyphase alternators, due regard must be paid to the purpose for which they are to be used, and though the variations necessary to meet such special circumstances are only of a minor character, they affect to a considerable extent the performance of the machines under working conditions. It is the adequate meeting of such conditions which determines the success of a design. In general, however, the following description covers the main features of the Preston alternator :—

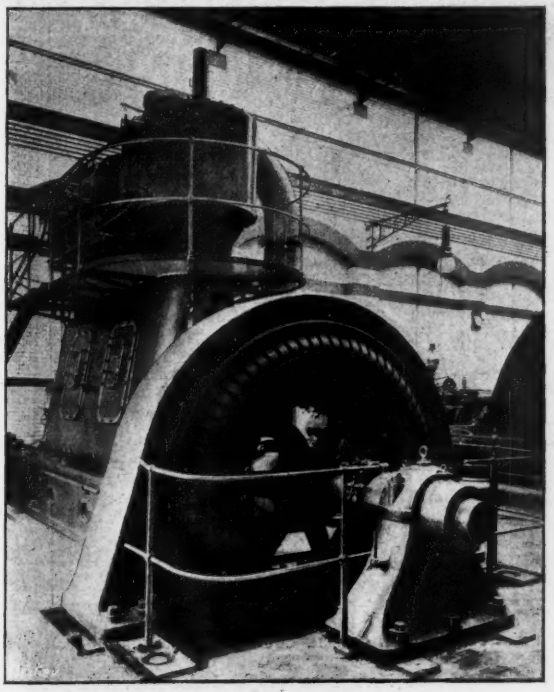
The rotor spider is made of cast-iron, and is of strong design, the hub being provided with a flange for bolting to the engine fly-wheel. It is invariably pressed on to the shaft by hydraulic pressure, and then keyed in place. On the spider rim, dove-tailed laminations are fixed by means of machined bolts and cast-iron flanges, the pole-pieces being then bolted on. The laminations are built up in such a way that ample spaces are provided at defined positions, the number and size of ventilating spaces being dependent on the width of the stator.



Dick, Kerr Standard 1,500 kw. Three-phase Alternator.

The pole-pieces are made of laminated steel, held together between two cast-steel end-plates of strong construction. The upper part is constructed of T shape in order to securely hold the field coils in position. The lower part of the pole-piece is dove-tailed for fixing on the rim of the rotor, it being then held in position by means of keys. The removal of field coils is effected by sliding the pole-piece from the dove-tailed groove parallel to the shaft without disturbing any other part of the machine, such an arrangement being of extreme convenience, not only when it is necessary to remove a field coil, but also for the removal of a stator coil. It should be added that the design and shape of the pole-pieces give a distribution of lines of forces in the air-gap calculated to produce an approximately sinusoidal wave of E.M.F.

In the winding of the field coils, it is obviously a mechanical advantage to use edge-wound strip, so whenever the excitation voltage permits, the field coils are wound with



600-kw. Two-phase Steam Alternator, Fulham.

a single layer of copper strip on edge, insulated between the turns by means of specially prepared fibrous material. The external surface of the windings is left practically bare, being protected merely by insulating varnish, which allows a rapid radiation of heat. In its assembled form, the general appearance of the rotor is shown in the figure on p. 690.

of the stator relative to the rotating field. The general construction of the stator frame is shown in the illustrations on the following page.

The frame is made of high-grade cast-iron, and is designed to allow complete ventilation of the laminations and at the same time to secure rigidity of the frame.

The core is made up of thoroughly annealed soft iron laminations, the individual laminations being well insulated from each other, to minimise eddy current losses. The laminations are held in position in the frame by means of machined bolts.

The winding is formed of separate coils, thoroughly insulated, having great rigidity, and a well-defined mechanical shape. The coils are former-wound, embedded in rectangular slots, and held in position by wooden wedges, and can be easily and quickly replaced. The upper and lower halves of a machine are shown on p. 690, with some of the assembled coils in position.

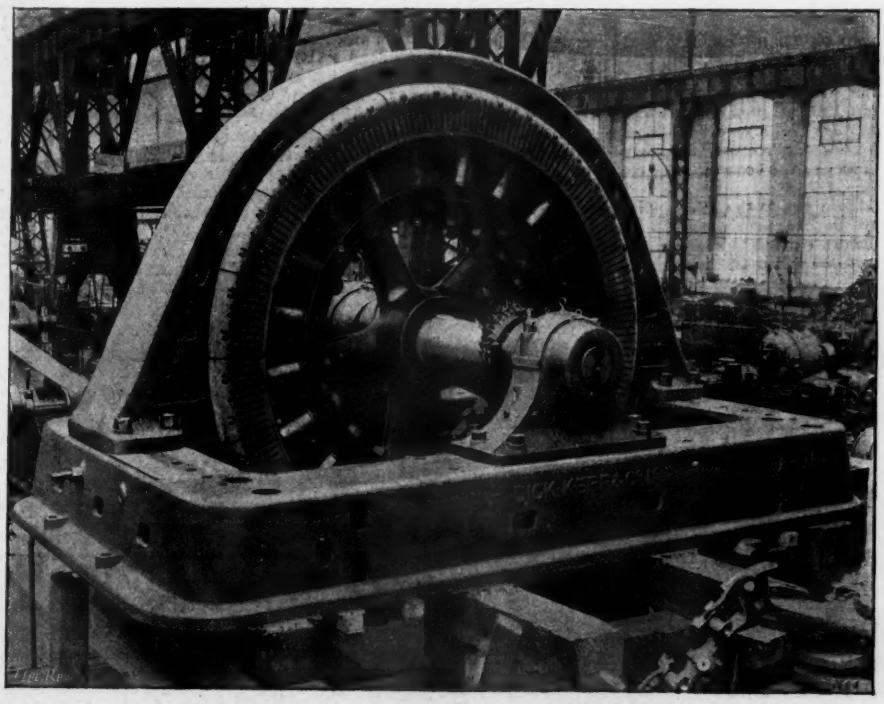
The connections between the stator coils are made by means of highly insulated cables, and are easy to trace.

The coils are protected outside the laminations by means of a cast-iron shield, in sections, bolted to the frame and easily removable. This shield is perforated, and does not interfere with the ventilation of the stator winding.

The collector is composed of rings of suitable metal, fixed to the shaft next to the rotor by means of a spider and insulated pins, ample provision being made for free air circulation round the same.

The brushes are made of carbon, of ample surface, are in duplicate, and can be set and replaced while the machine is running. The brush-holders are so constructed that the current will not pass through moving joints or tension springs, and will allow for tension adjustment.

The operation of testing completed alternators is of the utmost importance, and every machine is subjected to the severest tests before leaving the works. If a generator passes the high pressure test which is always imposed on the coils, it is extremely unlikely to break down after erection, because the humidity of the atmosphere in the neighbourhood of the works is so marked; while this is a condition extremely suitable for the staple industry of the



Dick, Kerr 3,750-kw. Three-phase Alternator for Shawinigan Falls, Canada.

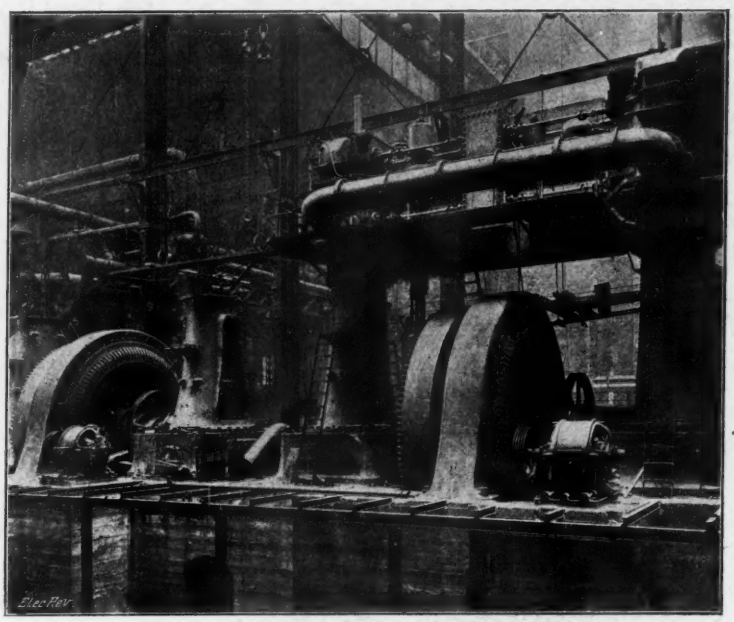
The stator frame, even in the largest type, is built in two halves, which are securely bolted together by means of finished bolts. The lower half of the frame is provided with feet, which rest upon the foundation bed-plate. In the larger machines the lower part of the under-frame is provided with a special screw for vertical and horizontal centring

district, viz., cotton spinning, it means that very high insulation is necessary to meet the rigid tests.

Of the two machines specially inspected on the occasion of a recent visit to Preston, in which we took part, one is a standard 1,500-kw. three-phase alternator, which is illustrated on p. 688, and is intended for railway

working; the machine is to be coupled to a horizontal engine, by Messrs. Yates & Thom, and gives its full output at 6,600 volts and 25 cycles per second. The second is a two-phase generator of a capacity of 3,750 KW., and has been constructed for the Shawinigan Falls Power Co., Canada. It is to be coupled to an Escher-Wyss turbine, running at 180 revolutions per minute, the frequency being 30 and the voltage 2,200. Quite a number of machines have been built at Preston for export to Canada, where competition with the United States is exceptionally difficult. This points to the possibility of business being secured under a favourable tariff, and it establishes once for all the fact that confidence has been renewed in English electrical machinery. Not only are Messrs. Dick, Kerr & Co. sending machines to Canada, but the ramifications of their business are enabling them to secure extensive orders for electrical machinery in Australia, Japan, South Africa, India, and other places abroad.

It remains to be added that the alternators have been constructed to the designs of Mr. A. P. Zani, who, possessing unique experience in alternator design gained both in the States and on the Continent, has been enabled to improve and modify in the direction of sound mechanical design and efficiency of performance. Mr. Zani, it should be stated, has the co-operation of a very able staff of engineers, who possess exceptional ability and knowledge of polyphase work.



1,500-KW. ALTERNATORS FOR THE LONDON COUNTY COUNCIL. (DEPTFORD.)

THE RAMSGATE TRAMCAR ACCIDENT.

BOARD OF TRADE REPORT.

LIEUT.-COL. VON DONOP has issued his report on the accident which occurred on August 12th, at Ramsgate, on the system of the Isle of Thanet Light Railways Co. A report of the inquiry appeared in the ELECTRICAL REVIEW for August 28th, page 333. After briefly describing the line and the occurrence he comes to the following conclusion:—

"Driver Collins's evidence was to the effect that he had his car well under control until he had nearly reached the bottom of the steep gradient, when the car seemed to shoot away and he lost control of it. He stated that he applied all his brakes and reversed his current, but without any effect; he accordingly released all his brakes and shouted to the conductor to apply the brakes at his end of the car, but the conductor was unable to do so before the collision occurred. The car was therefore at the time of the collision running freely down a gradient of 1 in 30.

"Collins attributed his losing control of the car to the fact of the rails being greasy and to his sanding arrangements having suddenly failed to act.

"As regards the state of the rails it is quite probable that they were in a greasy condition, but, as it had only just commenced to rain, Collins should have been prepared for this being the case.

"As regards the alleged failure of the sanding arrangements, Collins admits that they were acting efficiently up to the moment before the run-away occurred. The sand-hopper was examined after the accident, there was still sand in it, and the valve which released the sand was found to be working correctly. There is no evidence therefore to confirm Collins's view that the sanding arrangements failed.

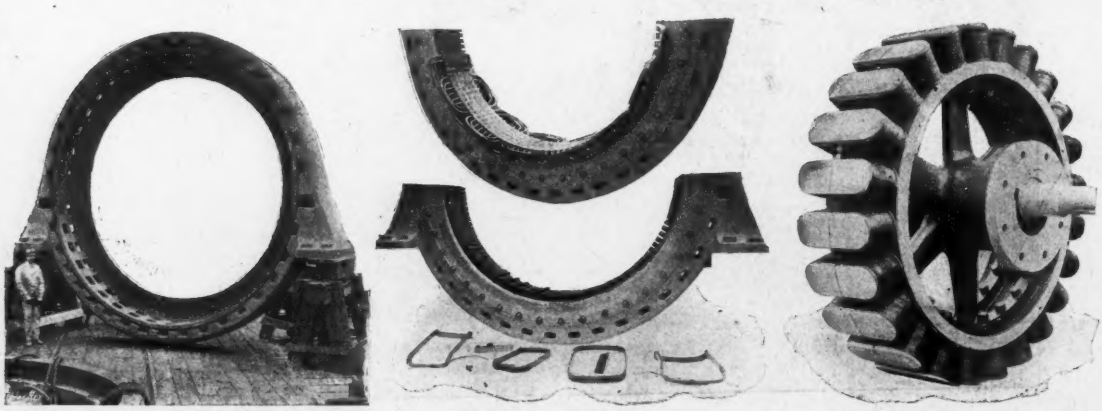
"As regards the fact of the reversed current having had no effect in stopping the car, this is accounted for by the fact that the trolley had at that time left the wire, though at the moment Collins was quite unaware of this fact.

"But the apparent failure of the brakes is not so readily explained.

"The hand brake and the rheostatic brakes in use on these cars are of the usual type but the track brake is of a novel design, which I do not think is in use on any other tramcars in the United Kingdom. It is a form which, it is understood, was designed by Mr. Humphries, the resident engineer and manager of the company, and was fitted to the bogie cars on these lines in accordance with the instructions of his directors.

"It consists of two steel skates, one of which is fixed in front of one of the large wheels at either end of the car. The two skates work independently of each other, each being applied from the platform at that end of the car near which it is fixed. When released, the skate is pressed by a spring between the wheel and the track, the spring tending to force the skate under the wheel, and thus bring the weight carried by that wheel on to the skate.

"This brake was primarily designed to prevent cars from running back. With this object, the conductor at the rear end of a car releases the skate at his end before commencing to ascend a steep gradient; the skate accordingly slides in behind the big wheel, and if that wheel should commence to revolve in the backward direction, the weight would immediately come on to the skate, and the speed



CARCASE OF STATOR. PARTLY WOUND STATOR. COMPLETE ROTOR ON TEMPORARY SHAFT.

would be at once checked. This brake appears to be an exceedingly effective way of checking cars when running back, and the company inform me that they have found it very efficient for that purpose.

"But it is further claimed for this brake that it is equally effective in preventing cars from running away in the forward direction. In this case the brake has to be applied by the driver. The skate slides in in front of one of the big wheels at the leading end of the car, and if that wheel be revolving in the forward direction, the weight immediately comes on to the skate, and the speed of the car is at once considerably checked. The brake is undoubtedly a powerful one, and if the wheel is revolving at all fast, the car is brought up with a considerable jerk.

"But an undoubted defect connected with this brake is that it is impracticable to apply it on the level before commencing to descend a steep gradient; for, when once it is applied, the wheel skids, and it would then not be safe to apply current to start the car; it is not, therefore, available for easing a car down a steep gradient, as is done with the usual form of slipper brake, and the company inform me that it is never used in that manner. As far as forward running is concerned, it is only available as an emergency brake to check the speed of the car when it has got out of the control of the other brakes.

"A further defect appears to be that unless the wheel in front of which the skate is applied is revolving, the spring will not suffice to force the skate under it; if, therefore, the wheel is skidding, the brake does not come into action, or at all events only partially so.

"It is admitted, therefore, that the car which ran away on this occasion started to descend the 1 in 12 gradient without any slipper brake being applied to it. It is probable that the driver's loss of control was primarily due to his running too fast down this portion, and then to his applying the hand and rheostatic brakes injudiciously, thereby causing the wheels to skid. Collins seems then to have entirely lost his head, as, instead of releasing his hand brake and applying his rheostatic brake fully, he released the latter, which, if the wheels were skidding, could not have been acting at all, and he then applied it again. Finally, as he was unable to check the car with the hand and rheostatic brakes, he removed both brakes, allowing his car to run free, and shouted to the conductor to apply the brakes at the rear end of the car; before, however, the conductor was able to do this the collision occurred.

"Collins states that after shouting to the conductor he reversed his current, and applied his track brake, but that that brake also failed to have any effect. It seems, however, to be very doubtful whether Collins ever did apply the track brake at all; it appears to have been in good order, and, if Collins's statement is correct, the wheels of the car were revolving quite freely at the time at which he tried it, so that there was nothing to prevent its coming into action at once. It is difficult, therefore, to understand why it should have had no effect at all, and it should undoubtedly have given the car a very severe jerk, which apparently it did not do. It is admitted that this track brake is very rarely used, except in running up gradients, and I am inclined to think that the drivers regard it as being provided solely for that purpose, and that Collins never thought of applying it on this occasion.

"Collins, by his account, manipulated his brakes in a most unskilful way, and it is to his want of skill that this accident must be to a great extent attributed. He has had considerable training at the work, but both his action and his evidence showed that he did not know how to make the best use of his brakes, and that he did not understand the working of the rheostatic brake.

"It was, however, specially with the view of preventing drivers from losing control of their cars that Major Pringle, in his report of October 12th, 1901, recommended the provision of slipper brakes, so that these might be applied before commencing to descend steep gradients. The 40 four-wheel cars belonging to the company have, it is stated, all been equipped with slipper brakes, which can be used in that manner, and since this was done there have, it is understood, been no cases of run-aways with those cars. But the brakes fitted to the 20 eight-wheel cars belonging to the company cannot be so applied, and it is to this defect that this accident must also be attributed.

"Until the company has fitted these eight-wheel cars with slipper brakes, which can be applied before the car starts to descend a steep gradient, I do not consider that Major Pringle's recommendation has been properly carried out.

"The company point out that the provision of such brakes is a matter of great difficulty, on account of the arrangement of the wheels on these eight-wheel cars. This may be so, but the problem must be faced, or the use of these cars be discontinued.

"The occurrence of this accident points, I consider, to the desirability of a compulsory stop being made in Bellevue Road at Albion Street on the descending journey, and that drivers should be instructed to apply their slipper brakes before commencing to descend this gradient."

SOME NOTES ON STEAM TURBO-ELECTRIC GENERATING PLANTS.*

By GEO. WILKINSON, Member.

IT is becoming generally recognised that where condensing water is available the steam turbo-generator has to-day established a record for reliability, efficiency and durability, which constitutes it a formidable rival to all generating plant in which reciprocating engines are employed, be they slow, medium or high speed. On April 23rd, 1884, the Hon. Charles A. Parsons filed his first applications for letters patent for turbine engines; one of these patents is entitled "Improvements in rotary motors actuated by elastic fluid pressure, &c.," and the specification sets forth many of the essential details to the construction of a successful and economical turbine engine.

Mr. Parsons' original patent rights having expired, the way has been opened for the manufacture of steam turbines by other engineers, and already such eminent firms as Messrs. Willans & Robinson, the Brush Electrical Engineering Co., the Westinghouse Co., and the British Thomson-Houston Co., have commenced to manufacture steam turbo-electric generators, while Messrs. Greenwood and Batley, of this city, have for years made and supplied turbo-generators of the De Laval type.

The De Laval Turbine.—In the modern construction of the De Laval type the steam is blown divergent from stationary nozzles, where expansion takes place, against vanes or buckets fixed in the circumference of a wheel, and the steam thus impinging on the vanes drives the wheel round and causes it to rotate at high velocity. There is only one row of buckets or vanes on the wheel, upon which the steam delivers most of its energy, and is afterwards exhausted either to the atmosphere or to a condenser in the ordinary way.

The steam nozzles are placed in very close proximity to the vanes of the turbine wheel, the clearance being only 2 mm., and consequently there is practically no loss of velocity between the steam jets leaving the nozzles and entering the vanes of the turbine wheel. The peripheral velocity of the wheel in the largest De Laval turbines does not exceed 1,380 ft. per second, while steam expanded from 150 lbs. pressure into a 28 in. vacuum can attain a velocity of over 4,000 ft. per second; thus the wheel falls far short of the theoretically economical speed.

The turbine wheel is adapted by an ingenious construction and method of suspension to operate at a very high peripheral velocity, and the speed is reduced and made available for dynamo driving by very perfectly made spiral cut gears, which effect a ten to one speed reduction. The dynamo armature is direct coupled to the gear wheel shaft of the turbine. The larger sizes of turbine dynamos have two armatures, so as to obtain a better distribution and balance in the turning effort; two sets of field magnets are provided and the armatures can be coupled either parallel or in series, or the machines can work direct on a three-wire system of distribution.

The speed is maintained constant by an exceedingly ingenious and compact centrifugal governor, mounted on the slower running gear wheel, which controls a double seated valve on the steam admission.

The following tables show the high efficiency obtained with the De Laval generators; they are, however, made up to 300 H.P. only, which is too small a unit for most public electricity supply stations, and so far as I am aware only direct current generators are supplied with these turbines.

TABLE I.

Results of Tests with De Laval Steam Turbo-Generators at Different Loads.

Turbine machine.	Pressure of admission steam. Lbs. per sq. in.	Vacuum inches of mercury.	No. of nozzles open.	Output in KW.	Lbs. of steam per KW.-hour.	Remarks.
50-H.P. turbine dynamo. Test made in April, 1895.	113·8	26·3	6	37	32·8	Work for condensing included.
	93·9	26·9	4	18·7	37·2	
				B.H.P.	Lbs. steam per B.H.P.-hr.	
150-H.P. turbine dynamo. Trial made in Nov., 1897.	113·8	26·4	7	163·0	*17·6	Work for condensing not included.
	113·8	26·2	5	114·5	17·9	
	112·4	27·0	3	64·1	19·0	
300-H.P. turbine dynamo. Test made in June, 1900.	126·6	26·98	8	337·45	15·68	Work for condensing not included.
	125·0	27·24	6	249·1	15·92	
	125·0	27·62	4	162·7	16·25	
	125·0	28·16	2	73·5	18·00	

* To get approximate lbs. of steam per KW.-hour, multiply by 10 and divide by 6.

The Parsons Turbine.—This turbine, which is by far the most important and extensively used at the present day, is of the parallel flow type. The turbine motor consists of a cylindrical case with rings of inwardly projecting vanes, within which revolves a concentric shaft carrying rings of outwardly projecting vanes. The rings of vanes on the case nearly touch the shaft, and the rings of vanes on the revolving shaft lie between those on the case and nearly touch the case.

The steam passes first through a ring of fixed guide vanes, and is projected in a rotational direction upon the succeeding ring of moving vanes, imparting to them a rotational force; it is then thrown back upon the succeeding fixed ring of guide vanes and the reaction upon the next ring of moving vanes increases the rotational force.

The same process takes place at each of the successive rings of guide and moving vanes.

* Abstract of paper read before the Leeds Local Section of the Institution of Electrical Engineers, October 22nd, 1903.

The energy to give the steam its high rotational velocity in each successive ring is supplied by the drop in pressure, and the steam expands gradually by small increments.

In the earlier types the steam was taken in at the centre of the fixed cylinder and operated on successive fixed and moving vanes, both right and left, exhausting at each end of the fixed cylindrical chamber, thus obtaining an approximate balance and little or no end thrust on the bearings; in the later designs the steam flows and operates upon fixed and moving vanes, in one direction only; the diameter of the fixed and revolving vanes are usually increased at least twice, and the three chambers thus formed are generally designated the high pressure, intermediate, and low-pressure cylinders.

To balance the end thrust imparted to the shaft by the steam operating upon the moving vanes, grooved pistons or dummies are used which rotate within corresponding seatings; the diameters of these pistons correspond with the diameters of the working cylinders, and a passage connects each working cylinder to the back of its corresponding balancing piston, and thus the end thrust is neutralised. The balance pistons also act as a practically steam-tight joint, since the clearance between the grooves can be adjusted longitudinally by a thrust block in the end bearing.

In order that the turbine shaft may set itself accurately in the centre of gravity, the bearings are constructed of a number of concentric loose fitting sleeves immersed in oil in such a manner that any transverse movement of the shaft is resisted by the fluid friction of the thin films of oil which have to be squeezed from the parts where the tubes are pressed against each other, thus the flexibility of the bearings is sufficient to compensate for any slight variation between the centre of the revolving cylinder and its true centre of gravity.

The armature of the electric generator is directly coupled to the turbo shaft by means of a steel sleeve; the shaft also carries a worm which drives a worm wheel, which in turn operates the lubricating oil force pump, and also the steam admission governor, by means of an eccentric or cam; when necessary the condenser air and circulating pumps are driven also from this slow running worm wheel.

The governing of the machine is as follows:—Steam is admitted to the turbine in a series of gusts by the periodic opening and closing of a double beat valve. This valve is operated by means of a steam relay in mechanical connection with the turbine shaft. The duration of each gust is controlled by an electric solenoid, which is connected as a shunt to the field magnets. The core of the solenoid is hung from the end of a long lever. The fulcrum of this lever is periodically moved up and down by means of a link connecting it with the eccentric, which receives its motion from the worm on the sleeve coupling, the eccentric also serving to work the oil pump. The short end of the lever controls the valve of the steam relay. Each periodic movement causes a gust of steam to be admitted to the turbine, the duration of the gust depending on the height of the distant end of the long lever.

With alternating current generators an ordinary centrifugal governor takes the place of and fulfills the functions performed by the before-mentioned solenoid; a second centrifugal governor is also provided which comes into action should the generator through any cause obtain an excessive and dangerous speed, when a trip gear is operated thereby and the steam automatically cut off from the plant.

One important factor which in the early times prevented the use of the Parsons turbine in alternating current stations was that the makers were unable to guarantee satisfactory parallel running of the plants.

About the year 1894 this difficulty was surmounted by modifying the governing in such a manner that the steam admissions were increased in frequency and shortened in duration, thus obtaining a more even angular velocity.

Several turbines of the non-condensing type were put down in the Manchester Square station of the Metropolitan Electric Supply Co., of London, when an injunction had been obtained against the company on account of the vibration caused by the reciprocating engines already installed. These turbo-alternators were of 350 KW. capacity, and gave complete satisfaction. Since that date the size of turbines has gradually increased, units of 500 KW. being put down in Newcastle, Scarborough, Cambridge, London, and other places.

In 1900, two alternators, each of 1,250 KW. capacity were made for the City of Elberfeld, Germany. The turbines were of the tandem type, consisting of high and low pressure cylinders, and ran at 1,500 r.p.m. The dynamos were four-pole, and supplied single-phase current at 4,000 volts and 50 periods. The steam consumption with slight superheat was 18·8 lbs. per KW.-hour at full load, or 11·2 lbs. per I.H.P., including the power required to drive the condenser pumps. These dynamos run perfectly in parallel with the 1,500 H.P. Sulzer engines which are coupled to 1,000 KW. Brown-Boveri alternators running at 83 r.p.m. In fact, the turbines steady the reciprocating engines, even when the latter are running on traction load.

During the last few years new designs have been brought out in which the consumption obtained has been further reduced, giving, especially in the larger sizes, some very remarkable results. A few examples of the amount of steam used by various sizes of turbines are given below.

A disadvantage in the Parsons plant is its great length, and there appears to be no good reason why it should not be shortened, the discs carrying the vanes being made larger in diameter to compensate. A convenient arrangement would be to place the plant thus shortened vertically, instead of horizontally, and I venture the opinion that the vertical type of turbo electric generator will eventually displace the horizontal type.

Returns published by Messrs. C. A. Parsons & Co., in May, 1903, show that the firm have supplied 50 turbines to corporations, ranging from 50 KW. to 1,800 KW., and aggregating 20,900 KW. also 73 turbines to electric supply companies, ranging from 50 KW. to 3,500 KW., and amounting to 31,880 KW. in the aggregate.

Westinghouse-Parsons Steam Turbine.—This steam turbine, built by the Westinghouse Co., is practically the same as the Parsons type, with the exception that the governor is placed between the turbo and the electric generator. A fly-ball type of governor is made use of, which has several features conducive to good regulation. The ball levers are swung on knife edges in lieu of pins. The governor works both ways—that is to say, the mid-position of the levers is admitting a full head of steam to the turbine. A movement from this in either direction is tending to cut off the supply. This serves a useful purpose in the event of a very excessive load coming on the turbine, such as a short-circuit, which has the effect of bringing down the speed more than the percentage variation permitted by the adjustment of the spring, when the steam immediately becomes shut off. Again in such an event as some of the governor driving mechanism becoming broken, and the governor balls slowing up independently of the turbine, the steam is shut off before any damage could take place.

50-kw. Steam alternator for Blackpool Corporation.

Pressure of Steam above Atmosphere at Stop Valve.	Superheat at stop valve.	Vacuum in the Turbine Cylinder Bar = 30 in.	Revs. per minute.	Load.	Steam used.	Steam used.
Lbs. per sq. in.	F.O.	Inches of Mercury.		KW.	Lbs. per hour.	Lbs. per KW. hour
126	0	28·0	5,044	52·7	1,480	28·0
132	0	28·5	4,880	0	320	—

300-kw. Three-phase alternator for De Beers' Mines, South Africa.

150·0	53 3	27 8	3,000	312·1	6,260	20·06
153·0	50·0	27·8	3,000	231·8	4,960	21·45
150·5	40·2	27 9	3,000	154 5	3,670	23·75

500-kw. Single-phase alternator (2,200 volts), for Hastings.

145	93	27·4	3,000	501·9	9,776	19·47
148	90	28 1	3,000	255·1	5,612	22 00

It may be of interest to note that the Westinghouse Co. have on order, and are building, about 85,000 B H.P. nominal capacity of turbines for use in this country. These include, among others, three 3,500-KW. turbo-alternators for the Metropolitan Railway of London, and eight 5,500-KW. turbo-alternators for the Underground Electric Railway Co., of London. In addition large sets are being built for the Corporations of Brighton and Liverpool.

The guaranteed maximum steam consumption of the 5,500-KW. plants at 165 lbs. steam pressure, and 27 in. vacuum per KW.-hour, is as follows:—Full load, 20·8 lbs. saturated steam, 17·7 lbs. with 150° F. superheat. Half load, 25 lbs. saturated steam, 21·2 lbs. with 150° F. superheat. The plants are also designed to take an overload of 50 per cent.

In these large turbines a departure is made from the regulation practice, inasmuch as steam is admitted at the centre of the casing and exhausts at both ends; a balance is thus obtained upon the duplicate sets of revolving vanes, and no steam balancing dummies are used.

Willans & Robinson Steam Turbine.—This is practically a Parsons turbine with the following modifications:—While efficiency in the Parsons turbine depends upon the small clearances between the outer ends of the turbo vanes and the cylinder casing, and also between the ends of the fixed vanes and the revolving cylinder, in the Willans these peripheral clearances are disregarded and reliance for efficiency is had upon the small clearances on the sides of the vanes at their outer ends. The rotating rings of vanes (and also the fixed ones) are enclosed by a double hoop of thin metal which moves with the vanes; the edge of this ring comes fairly close to the continuous collar which forms the root of the next fixed ring of vanes. The clearance is very small, and it is claimed that if the hoop touches the fixed collar it will do no harm, but will almost immediately wear itself into the proper position.

There are other minor details in connection with the governors, bearings and casing, introduced with a view to simplification, and the makers are prepared to guarantee, with high pressure superheated steam and a good vacuum, a steam consumption not exceeding 17 to 18 lbs. per KW.-hour on a 1,000 KW. turbine coupled to an alternating current generator.

Brush-Parsons Turbo Generator.—So far as the steam portion of this plant is concerned, it is built to the Parsons designs with one or two detail modifications in connection with the oil circulation and cooling; the alternator is of the fixed armature type with revolving field magnets. Although the Brush Co. have only recently taken up the manufacture of this class of plant, an examination of the various parts during construction convinces me that the Brush Co.'s production will prove itself to be one of the best and most reliable of turbo-generators.

The Curtis Steam Turbine.—The shaft in this turbine is vertical, the lower end carrying discs of large diameter within the steam casing on the periphery of which the steam vanes are carried, the stationary rings of vanes being fixed to the cylinder casing. On the upper end of the shaft the revolving field magnets are mounted, and the stationary single or polyphase armature coils are located in grooves formed in the laminated iron discs surrounding field magnets, the whole being protected by a metal casing in the shape of an inverted basin; at the extreme upper end of the shaft the centrifugal governor is located, which controls the plant in the novel manner described later.

Velocity is imparted to the steam in an expanding nozzle or nozzles, so designed as to efficiently convert into velocity nearly all

the expansive force of the steam between the pressure limits used. After leaving the nozzles, the steam passes successively through two or more lines of vanes on the moving element, which are placed alternately with reversed vanes on the stationary element.

In passing successively through these moving and stationary elements, the velocity acquired in the nozzle is abstrated, and largely giving up to the moving element. By virtue of the large diameter of the discs carrying the vanes a high steam velocity is made to efficiently impart motion to a comparatively slowly moving shaft. The steam inlet area is made up of a number of expanding nozzles adjacent to each other, so that the steam passes to the wheels in a broad belt when all the nozzle sections are in flow.

This process is repeated two or more times, the devices for each repetition being designated as a stage. The number of stages and the number of lines of vanes in a stage are governed by the degree of expansion, the peripheral velocity which is desirable or practicable, and by various conditions of mechanical expediency.

The governing is effected by the successive opening or closing of the high pressure set of steam nozzles and consequent widening or narrowing of the active steam belt. The first expansion nozzle is controlled by a throttling device operated by the governor, and the remaining nozzles are opened or closed electrically by a small electric controller which is moved round by the governor.

The downward thrust due to the pressure of steam against the vanes is not balanced by steam pistons or dummies, as in the Parsons type, but the whole revolving mass is floated up on a thin film of oil which is forced up beneath the footstep bearing by an oil force pump.

High efficiencies are obtained with this plant, and with 125 lbs. steam pressure superheat of 100° F. and 28 in. vacuum, the makers guarantee maximum steam consumption per KW.-hour, exclusive of the power required for operating the condenser pumps and driving the exciter, as follows:—

Size of plant.	Full load.	Half load.	Quarter load.
KW.	lbs.	lbs.	lbs.
750	19·9	20·9	24
1,500	19 3	20·2	23·2

Under the same conditions, but with 140 lbs. steam pressure and 28½ in. vacuum, a 600-KW. Curtis generator at 1,500 revolutions per minute gave on test a consumption of 19¼ lbs. of steam per KW.-hour on full load, 19⅛ lbs. on 25 per cent. overload, 20¾ lbs. on half, and 22⅔ lbs. on a quarter load.

The following are some of the distinctive features of the Curtis turbo-generator:—(*a*) The short vertical height occupied by the steam portion of the plant and the strength of the steel turbine vanes. (*b*) The extremely small floor space occupied. (*c*) The excellent ventilation obtained in the alternator. (*d*) The uniform turning movement obtained by the continuous supply of steam to the turbine.

Possible disadvantages are that the generator carries no exciter, and the condenser pumps cannot be driven direct from the turbo shaft.

It is probable that the reciprocating steam engine will still maintain its superiority over the steam turbine for driving direct current generators of large size, inasmuch as at the high speeds necessary with turbines there is difficulty in constructing a satisfactory direct current revolving armature; the armature reaction necessitates either a special compensating winding or the shifting of the brushes for changes in load, and the excessive peripheral velocity and vibration of the commutator precludes the use of carbon brushes, which would probably soon become red hot.

Hitherto most of the high tension alternating current turbo-generators have been constructed with revolving armatures, a practice which is to be condemned, inasmuch as with the excessive centrifugal strains and vibration due to high velocity it is difficult to maintain good insulation of the high pressure generating coils; also the excessive velocity of the collecting rings causes cutting of both the rings and the collecting brushes; a considerable amount of metal dust is thrown off at the point of contact, and in long continuous runs this metal dust is apt to collect and break down the insulation of the high pressure collecting rings or brushes. In the writer's experience both these causes have produced breakdowns in turbo-generators with revolving armatures. The ideal arrangement is a fixed armature with the field magnets revolving within it.

Economy of space and buildings may be readily set forth by comparing the 3,500 KW. Sulzer-Kolben two-phase generators at the Willesden works of the Metropolitan Electric Supply Co., with turbo-generators of equal output.

The Sulzer-Kolben plant weighs, with condensers, approximately 585 tons, the space occupied by the foundations is 60 ft. 2 in. in length × 21 ft. 6 in. in width, with a vertical height above the engine room floor to the top of the piston tail rods of 33 ft. 4½ in.

A Parsons turbo-generator of the same output weighs approximately 148 tons, and the space occupied does not exceed 37 ft. 1 in. in length × 8 ft. in width and 14 ft. 6 in. in height, plus about an equal depth for the condenser room beneath.

A Curtis turbo-generator of 5,000-KW. output weighs approximately 175 tons, and the space occupied does not exceed 20 ft. × 15 ft., with a vertical height not exceeding 30 ft. In this size the condenser, turbine, and generator are arranged vertically, the condenser forming the base of the plant.

Economy in Steam Consumption.—According to the published data the maximum steam consumption guaranteed by the builders of the Sulzer-Kolben plant works out with saturated steam at 150 lbs. pressure and a vacuum of 24 in. at:—22·2 lbs. per KW.-hour at full load; 23 lbs. per KW.-hour at half load.

The makers of the Parsons turbo-generator guarantee the steam consumption, with steam at 150 lbs. pressure, vacuum of 28 in., and superheat of 100° F.:—17·5 lbs. per KW.-hour at full load; 20 lbs. per KW.-hour at half load.

At low loads the efficiency of turbo plants is shown by published returns to be superior to that of ordinary steam engine generators of equal capacity.

A further interesting comparison in this respect is given below between the most economical of the two 1,400-KW. two-phase plants with triple vertical engines recently installed in the Leeds Electricity Works, and the 1,750-H.P. direct-current turbo plants installed last year in the works of the Newcastle and District Electric Lighting Co.:—

Town.	Speed.	Superheat.	Kilowatts.	Steam pressure.	Vacuum.	Water per KW-hour.
				lbs.	ins.	lbs.
Leeds ...	200	76° F.	1,400	183	25·6	19·9
Newcastle	1,710	237° F.	897	145	26·5	17·73

Other advantages which may be named are as follows:—

1. No expensive cylinder oil is necessary.
2. There is no oil in the condensed water.
3. There are no "big ends," packings, and bearings to take up.
4. There is less difficulty in maintaining a good vacuum, there being no piston and valve rod packings through which air may gain admission to the condenser. The importance of a good vacuum is obvious in view of the fact that every 1 in. of vacuum above 25 in. or 26 in. has been found to reduce the steam consumption by about 4 per cent.
5. A greater degree of superheat may be maintained with a great gain in efficiency and no danger.

Tests on a 500-KW. turbo-generator have shown an improvement in steam consumption resulting from a superheat of 50° F. of about 8 per cent., and at 100° F. it averages about 12 per cent.

In a recent paper read before the Institution of Naval Architects, Prof. W. H. Watkinson made the following interesting observations on this subject:—

"The steam turbine is the only engine in which condensation of the steam by previously cooled internal surfaces does not take place; but the steam in turbines is, of course, wet from another cause, namely, on account of the expansion it has undergone while doing work, and the efficiency of this type of motor is very considerably increased when the steam is superheated prior to its admission to the engine. In steam turbines the reduction in the amount of steam required when superheated steam is used is due mainly to the increased volume and the decreased frictional resistance between the rotating vanes and the steam."

So long as proper adjustments are maintained between the fixed and moving vanes the efficiency as to steam consumption appears to be well maintained. This is shown by comparing a test made by Prof. Ewing on a 500-KW. turbo-alternator, driving its own air and circulating pumps, which had done heavy duty at the Cambridge Electricity Works for a period of 12 months, with a test made on the same plant 14 months earlier by the Cambridge Electric Supply Co.'s engineer, as set out below:—

Date of test.	Steam pressure.	Vacuum.	Load in KW.	Lbs. steam per KW.-hour.
	lbs.	ins.		lbs.
Prof. Ewing's tests, January, 1901	148	27·8	518	25
	151	28·2	273½	28·3
Engineer's tests, October, 1899	139	24·5	526·4	24·1
	145	26·6	256·1	27·5

In Prof. Ewing's tests the steam was not superheated, and there was no water separator, but water which collected in a pocket under the vertical limb of the steam-pipe leading to the engine was from time to time blown off. In the case of the engineer's tests in 1899 dry steam was used, and the turbine was not driving its own pumps. Prof. Ewing concludes his report as follows:—"Considering the altered conditions in these two respects, I am of opinion that the results of the present trials show that there has been no deterioration due to wear."

This test is confirmed by the following tests taken on a 300-KW. Parsons turbo-generator under my own control, in which the tests made at the Harrogate Electricity Works in February, 1902, are compared with tests made in the same works and under precisely the same conditions after over nineteen months' heavy work.

Date of test.	Steam pressure.	Superheat.	Vacuum.	Load in KW.	Speed.	Lbs. steam per KW.-hour.
	lbs.	lbs.	ins.			
Feb. 19, 1902						
Full load ...	130·5	41·9° F.	28	309·5	3,010	22·76
Half load ...	131	45° F.	28·8	157·4	3,010	25·1
Sept. 30, 1903						
Full load ...	130	35° F.	28	307·5	3,080	21·12
Half load ...	130	33° F.	28	127·1	3,080	23·24

It will be noted that the results of the 1903 tests are better than those of 1902, which may be partially owing to the increased speed, but chiefly to the fact that a number of the vanes in the high pressure end were found broken off on opening out after the tests of

1902. In concluding these notes I have to express my thanks to Messrs. Parsons & Co., the Brush Electrical Engineering Co., the Thomson-Houston Co., and to Messrs. Greenwood & Batley, who have willingly placed data at my disposal.

STANDARD DIRECT CURRENT PRESSURES AND STANDARD FREQUENCIES.

The following is a copy of the resolutions of the Engineering Standards Committee on these important matters:—

The standardisation of electrical pressures and frequencies was the first portion of the important work entrusted to the Sub-Committee on Generators, Motors and Transformers by the Electrical Plant Committee. The Sub-Committee consists of the following gentlemen:—

Colonel R. E. Crompton, C.B., *Chairman.*
Colonel H. C. Holden, R.A., Captain A. H. Dumaresq, R.E. } *Representing the War Office.*
Commander G. L. Sclater, R.N., L. J. Steele, Esq., } *Representing the Admiralty.*
Llewellyn Preece, Esq., *Representing the Crown Agents for the Colonies.*
Dr. R. T. Glazebrook, *Representing the National Physical Laboratory.*
B. H. Antill, Esq. W. B. Esson, Esq. } *Nominated by the Electrical Engineers' Plant Manufacturers' Association.*
A. C. Eborall, Esq.
S. Z. de Ferranti, Esq.
Robert Hammond, Esq.
Captain H. R. Sankey.
C. H. Wordingham, Esq.
Leslie S. Robertson, Esq., *Secretary.*
C. le Maistre, Esq., *Electrical Assistant Secretary.*

At an early stage in their deliberations, the Sub-Committee decided that the most advantageous method of approaching this problem, beset as it is with so many difficulties, would be from the point of view of those most affected, namely, the users of lamps and of motors for power purposes. It was therefore agreed that the standard pressures to be suggested should be measured at the consumers' terminals, as settled by Act of 1899.

At the present time there exist many different pressures declared by the various lighting and power authorities. In view of the great desirability of obviating this unsatisfactory state of affairs, it was deemed advisable to suggest the minimum number of standard pressures which would best meet present commercial requirements, and, at the same time, utilise to the fullest extent the consumers' existing appliances.

After careful consideration, it become evident to the Sub-Committee that the direct current pressures of 110, 220, 440 and 500 volts, would best meet the requirements, because carcases built for these standard pressures could be utilised for pressures 10 per cent. above or below the suggested standards, without any alteration whatever in the castings or mechanical components, by merely altering the windings and excitation.

It is to be hoped that now these direct pressures have been fixed as standards by the Committee, they will in future be universally adopted by the engineers advising corporations and others distributing electrical energy. In course of time the benefits to the electrical industry at large, which will certainly follow the adoption of these standard pressures, must become more and more apparent.

A circular was drafted embodying the suggestions of the Sub-Committee, and this was submitted, first, to the manufacturers for their consideration, and secondly, to the leading consulting engineers and users of motors.

The information so courteously placed at the disposal of the Sub-Committee by the consulting engineers and manufacturers was most carefully weighed and considered by the Sub-Committee, and certain definite conclusions were arrived at, the circular being sent, in the first instance, to the manufacturers, as they were the people most directly interested. Replies were received from all the leading firms, who expressed themselves unanimously in favour of the recommendations of the Sub-Committee. The consulting engineers similarly gave their adherence to the proposals of the Sub-Committee.

Before coming to their final decision the Sub-Committee on Generators, Motors and Transformers conferred with the Sub-Committee on Electrical Tramways, of which A. P. Trotter, Esq., is chairman, and a joint meeting took place, with the result that the pressure of 500 volts, which most concerned the latter Sub-Committee, was agreed to, and, in addition to the pressures already agreed to, 600 volts was decided upon as the standard pressure for electrical railways.

The question of the adoption of standard frequencies, although of equal importance with that of standard pressures, was not surrounded with the same difficulties. It was, however, deemed advisable to fix upon the standard frequencies at the earliest possible stage of the work, as no progress could be made in the standardisation of prime movers for driving alternate current machinery until such time as the frequencies had been settled upon. On this question there appeared to be a great preponderance in favour of frequencies of 25 and 50. The only point upon which any serious difference of opinion appeared to exist was the advisability of the adoption of a third frequency of 40 or 42, to enable rotary converters to be used to the fullest advantage. All the arguments in favour of this third frequency were fully discussed, but after carefully weighing the *pros* and *cons*, the Sub-Committee decided not to recommend the adoption of more than two frequencies, namely, 25 and 50.

The recommendations of the Sub-Committee were then submitted to the Electrical Plant Committee, the Publication Committee, the Main Committee, and the Board of Trade for their approval.

This having been obtained, it was deemed advisable, in the interests of the electrical industry of the country, that the findings on the questions of direct current pressures and frequencies should be published at an early date, without waiting for the completion of the entire report to be issued at a later date.

The following are the resolutions on standard direct current pressures and standard frequencies:—

1. That the standard direct current pressures, measured at the consumers' terminals, be 110, 220, 440, 500 volts.
2. That the standard direct current pressures, measured at the terminals of the motors, be:—For tramways, 500 volts; for railways, 600 volts.
3. That 25 periods per second be the standard frequency for:—
   (A) Systems involving conversion to direct current by means of rotary converters.
   (B) Large power schemes over long distances.
   (C) Three-phase railway work, where motor gearing and the inductive drop on the track rail have to be considered.
4. That 50 periods per second be the standard frequency for:—
   (A) Mixed power and lighting on town supply mains.
   (B) Ordinary factory power plant.
   (C) All medium sized power plant where rotary converters are not employed.

MANCHESTER CORPORATION AND ITS ELECTRICAL ENGINEER.

(From our Manchester Correspondent.)

The resignation by Mr. G. F. Metzger of his position as electrical engineer to the Manchester Corporation has occasioned a great deal of comment, and the action of the Electricity Committee with regard to him will be discussed at the meeting of the City Council this week. Many members of the Corporation regret the circumstances which have arisen, and are not willing that an exceptionally able public servant should sever his connection with the city if it can be prevented. All the official information obtainable upon the subject, until a day or two ago, was to the effect that Mr. Metzger had resigned because of a certain "misunderstanding" as to the terms of his appointment. That was the statement communicated to the Press at the close of the meeting at which the resignation was tendered. It does not, however, contain the whole truth. Another meeting has since been held "to discuss the terms in which Mr. Metzger's resignation should be reported to the Council." It was proposed then, that the excuse about a "misunderstanding" should be repeated, but this being objected to by the gentleman most intimately concerned, a more correct version was given for insertion in the epitome of the Committee's proceedings, to be presented to the Council. The epitome, circulated on Monday last, contained the following reference to the matter:—

"*Memorandum.*—Mr. Metzger tendered his resignation on the ground of his inability to work in unity with the deputy-chairman.

"*Resolved.*—That Mr. Metzger's resignation of the position of chief engineer to this department be and is hereby accepted."

The circumstances leading up to the resignation have now been given to the public.

In January, it appears, the Halifax Corporation approached the Manchester Electricity Department for permission to obtain the services of Mr. Metzger, in his private capacity, of course, to supervise some technical matter connected with their electricity undertaking. Mr. Howarth, chairman of the Committee, and Mr. Hesketh, the deputy-chairman, refused the permission, without reference to the Committee, and without even informing Mr. Metzger that it had been made. A few months later Mr. Metzger was applied to by the Burslem Corporation in a consultative capacity on a matter regarding some tenders, and his services as arbitrator were also solicited by the Trafford Park Power Supply Co. in some dispute they had with contractors over a double-current generator. In both these cases Mr. Metzger applied to the chairman of the Committee for permission to act, and that permission was given. The work was done in the evenings, after "office hours," and there, apparently, was an end of it.

Mr. Metzger had previously been involved in some controversy with the deputy-chairman of the Committee regarding the Stuart Street installation, which was said to be in excess of the city's requirements. Dr. Kennedy was asked by the Committee to report on that question, and he did so. Both Mr. Hesketh and Mr. Metzger accepted the report, and the former gentleman disclaimed all personal feeling in the matter. Affairs proceeded smoothly until, after an interval of three months, Mr. Hesketh called the Committee's attention to the outside work done by Mr. Metzger (referred to above), contending that it was a breach of his agreement with the Corporation. There was, however, no clause in the agreement binding the engineer to devote himself exclusively to the

duties of his position, though a stipulation to that effect is said to have been embodied in a letter written to him at the time of his appointment.

The chairman, in the course of the discussion, acknowledged that he had given Mr. Metzger permission to do the work, and urged that he had acted quite innocently and in ignorance of any stipulation to the contrary. The Committee took a broad view, and decided, by 17 votes to 3, to draft a fresh agreement, in which private work should be absolutely forbidden.

It was at this meeting, after a heated discussion, that Mr. Metzger resigned.

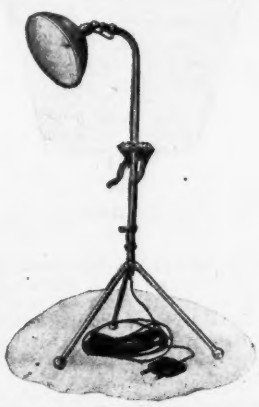
A Manchester contemporary remarks:—"Manchester people will scarcely have forgotten how Mr. C. H. Wordingham, the predecessor of Mr. Metzger, was driven to resignation by a policy of pin-pricks and criticism, only to obtain a post of far greater importance as advising electrician to the Admiralty. Cannot the lesson of that episode be applied to the present situation?"

DEVICES AND FITTINGS FOR THE CURRENT ELECTRIC LIGHTING SEASON.

(*Continued from page* 657.)

Electric Reading Lamp.

The illustration shows a new domestic adaptation of the "Ever-Ready" lamp, in the form of a neat nickelled reading lamp. It is equally convenient as a mirror lamp for shaving or toilet table purposes, as the legs may be folded up for clipping it to a mirror. The "Ever-Ready" dry battery which yields 60 hours' light, is placed beneath the table or desk. It is being supplied by



"Ever-Ready" Reading Lamp.

the American Electrical Novelty and Manufacturing Co., Ltd., of Charing Cross Road, who have just issued several small lists of their cigar lighters, and their electric lamps for lighting the interior of vehicles.

Veritys' Switches.

Messrs. Veritys, Ltd., have lately issued their No. 61 circular dealing with main switches, switchboards, and switchboard components

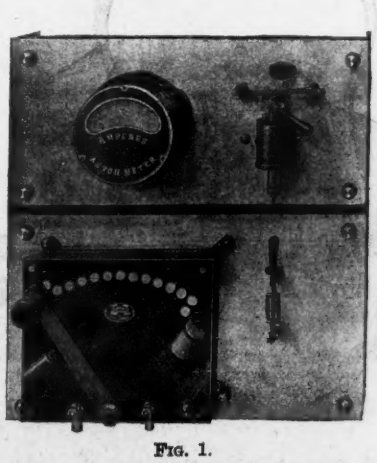


Fig. 1.

other circulars of the same series have before been noticed in these columns, and when all are contained in their green manilla file they form a current catalogue. All apparatus, such as knife switches, voltmeter switches, shunt-breaking switches, circuit breakers, &c., are priced both mounted and unmounted; leading dimensions are given, and the list should thus be useful to consulting engineers, contractors, and others who frequently require to speedily make up approximate estimates of switchboards. The twin-blade knife switch is listed in single, double, and triple-pole, mounted and unmounted, with and without fuses, and for single and double throw, while extra rates are quoted for the attachment of carbon breaks and the substitution of marble for slate bases. The absence of a rear contact is noticeable, but Messrs. Veritys claim that the electrical resistance is actually lower than in a similar switch with a supplementary rear contact. The spring washer necessarily used for the pivot is said to ensure a tight contact.

Fig. 2 shows a gas-tight, double-pole 25-ampere switch of a type useful for colliery and rough work generally. Full particulars are given of the Peard fuse, together with the house service Peard fuse, which is the latest development of this well-known cut-out. The

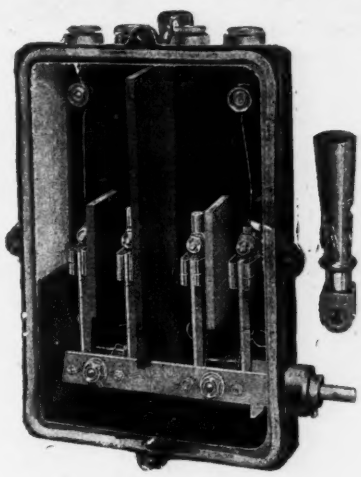


Fig. 2.

V.S. automatic circuit-breakers follow. These were referred to by us some little time ago. One of the chief advantages claimed for them is that they may be used as main switches as well as breakers, and thus, on traction boards, for instance, single-pole switches may be dispensed with. Moreover, the breaker cannot be thrown into circuit in the presence of an overload. A selection of small switchboards suitable for private installations is given. In fig. 1 we illustrate the two-panel type motor-starting board. In this design a panel is reserved for each pole; one pole can be broken by a single-pole switch, and the other by a small V.S. circuit-breaker. An ammeter is provided on one pole, and a single automatic starting switch upon the other. These panels are claimed to be more satisfactory than double automatic starting switches.

Baxendale's New Devices.

Messrs. Baxendale & Co., of Miller Street, Manchester, have recently put on the market a new arc lamp winch (fig. 1); it is introduced to meet the demand for a cheaper article. It is claimed to have all the advantages of the ordinary winch; the handle itself is detachable, and the pawl and teeth are so shaped that it

Fig. 1.

Fig. 2.

is impossible for the pawl to be released without the handle being in the winch, that is to say, when once the arc lamp is wound up and the handle taken away, it is impossible for it to drop. Fig. 2 shows a new standard fitting designed more especially for draughtsmen's desks, technical laboratories, &c., or any place where the light is required to be concentrated in a certain small area. The pillar of the lamp revolves on the base, and a special patent body enables the arm of the fitting (which, by the way, is loose in the body of the swivel),

to be moved up or down, so that the lamp itself can be fixed in any position whatever with very little trouble. The special shape of the reflector makes it peculiarly suitable for this class of work. Messrs. Baxendale have also introduced a carrier for use with the B. pattern Nernst lamp (figs. 3 and 4). Hitherto it has been impossible to use an ordinary shade and obtain anything like a neat effect; but by

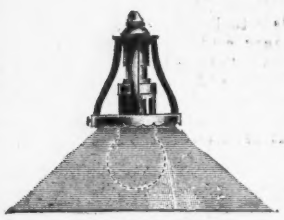


Fig. 3.

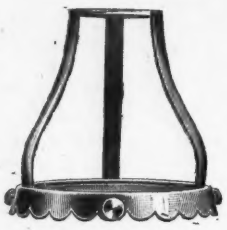
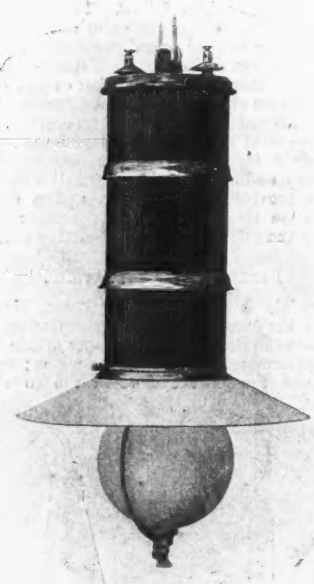


Fig. 4.

fitting this carrier on to the S.C. of the lampholder, a 3¼-in flanged shade of any pattern can be used with the lamp, and the carrier is so proportioned as to place the shade in the best possible position. The same firm are also designing a carrier to enable the reflector to be used with a large Nernst lamp for inverted lighting.

The "Arcazon" Lamp.

This long-burning arc lamp is manufactured by the New British Engineering Co., Ltd., of Horsell Road Works, Holloway Road, N. The standard single enclosed type for continuous current is only 26 in. in length, and weighs only 16½ lbs.; that for alternating current is only 24 in. in length. A 5-ampere 100-volt direct current pattern burns for 100 hours at one trimming and gives 2,100 N.C.P. The continuous-current lamps can be burnt 2, 3, 4 or 5 in series with automatic cut-out and substitutional resistance. The alternating current lamp can be burnt 3 in series on 250 volts. The "Arcazon" lamps are largely used in chemical works, iron foundries, and factories, where naturally they have to burn under very stringent



The "Arcazon" Lamp.

conditions. It is claimed that dust, chemical fumes, smoke, and weather have no effect whatever on the mechanism of the lamp, and there is nothing whatever to deteriorate in the working parts. Lamps of this type have been supplied to run on alternating (single or polyphase), direct, and rectified circuits. The choking coil supplied with lamps to burn on alternate current circuits is efficient and silent. The resistance supplied with the lamps to run on direct current circuits is wound on porcelain insulators at the end of a star casting, this resulting in a rigid design and high insulation.

The Dalite Lamp.

The Jandus Arc Lamp and Electric Co., Ltd. (sole agents, Messrs. Drake & Gorham, Ltd.,) of Victoria Street, S.W., have introduced this new arc lamp to meet the special requirements arising in dye-houses, calico and colour printing establishments, drapers' premises, art studios, and so on, where matching of colours calls for a perfect daylight substitute. Indeed, the "Daylite" (Dufton-Gardner patent) lamp is said to be more constant and reliable than daylight itself in the winter months. The lamp consists of an arc lamp of the well-known Jandus pattern enclosed in a lantern of tinted glass of special manufacture, which so modifies the light as to bring it into exact agreement with daylight. Each lamp is tested and adjusted to accord with the light from a north sky on a bright day. The lamp was exhibited before the British Association in Bradford in the autumn of 1900, and we understand it has been critically tested in some of the leading dye-houses in Bradford with satisfactory results. The light is said to be very steady, soft and diffused, and to

The Dalite Lamp.

have none of the piercing rays and dense shadows accompanying the ordinary electric arc illumination. It seems to us that the lamp should have many opportunities of proving its value, especially in the Midland and Yorkshire manufacturing districts. It has already been adopted by many of the leading dyeing firms, and in the Jandus Co.'s "Dalite" catalogue a number of testimonials from users of this class are printed.

Prometheus Heating Apparatus.

An improved form of electric flat-iron is shown in fig. 2. It is supplied by the British Prometheus Co., of Kingston-on-Thames, for domestic purposes. The company make about 20 different patterns of irons suitable for domestic, tailors', laundry or hatters' use, and a great increase in the use of electrically-heated apparatus

Fig. 1.

is reported. Many laundries throughout the country have been fully equipped with "Prometheus" irons, and with satisfactory results, the absolute cleanliness and the improved health conditions being two strong points in favour of the apparatus. It is interesting to learn that many firms are scrapping gas-heated and other

appliances in favour of electrically-heated apparatus. Fig. 1 shows their new 3-pint copper kettle, which has just been put on the market. It is substantially made, and has been designed more

Fig. 2.

for hard work than to please the artistic eye. The British Prometheus Co. are at present putting the finishing touches to a new radiator pamphlet, and they hope to issue same in the course of a week or two.

"Ediswan" Accessories and Fittings.

The Edison & Swan United Electric Light Co., Ltd., at the present moment have a large selection of novelties in the way of accessories. Particulars of all may be found in their various leaflets, but we illustrate a few below. Fig. 1 represents a neat oblong single-pole cut-out, which is made in four sizes, suitable for 5, 10, 25 and 50 amperes. Not only are the terminals separated from one another by

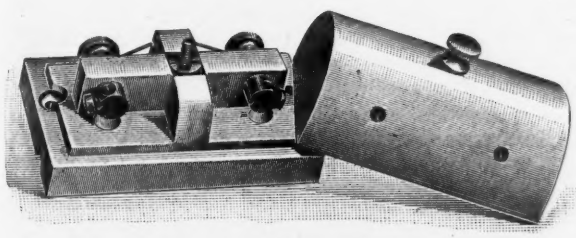


Fig. 1.—Ediswan Single-pole Cut-out.

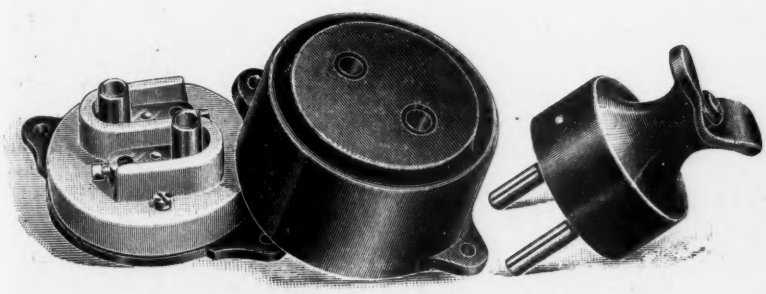


Fig. 2.—Ediswan Wall-plug and Socket.

substantial china walls, but when the cover is in place the interior is divided into four distinct compartments; an arc is thus impossible, and it is claimed that no damage can result with a dead short. Fig. 2 shows the "Ediswan" cast-iron wall plug and socket, suitable for theatres, mills, &c. They have also a new fuseboard—the Economic type—with fuses 3½ in. in length. Another accessory is the new "Wedge" pattern tumbler switch (1009).

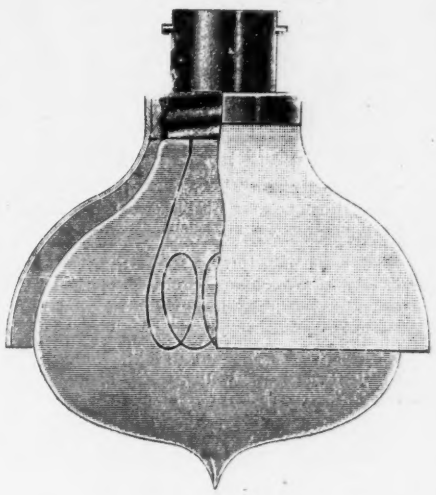
The "Ediswan" D.P. new key-holder is an improvement on the original pattern. It is said to be the only D.P. key-holder on the market, and renders it possible to completely isolate a high-voltage lamp. All of the above devices are suitable for 250 volts. Amongst the company's miscellaneous novelties is the "Litetite" photographic lamp (fig. 3), by means of which the light can be regulated and increased as the process of development proceeds.

The Ediswan Co. list a large assortment of artistic "Repoussé" switch and plug covers, which are hand-hammered and beautifully finished.

The company's artistic fittings catalogue is now in the press. A few of their latest designs were illustrated in our issue of September 18th.

Lamp Reflector.

Messrs. Goossens, Pope & Co., of Basinghall Street, E.C., are supplying a new opal reflector for incandescent lamps. It is shown in the accompanying cut, and, as will be seen, the shade screws



firmly on to the lamp. It is easily detachable, and is claimed to increase the illuminating effect and to economise the current consumption.

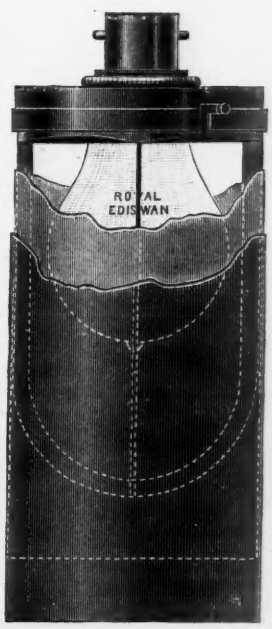


Fig. 3.—"Litetite" Photographic Lamp.

LEGAL.

Wilde *v.* Thompson.

Lords Justices Vaughan-Williams, Romer and Stirling, in the Appeal Court on Monday, had before them an appeal by the plaintiff in this action against the decision of Mr. Justice Buckley dismissing the action on the ground that the statement of claim disclosed no cause of action. The plaintiff, Dr. Henry Wilde, an electrical engineer, claimed to be the inventor of dynamo-electrical machinery, and took proceedings against the defendant, Prof. Silvanus Thompson, for libelling his trade reputation by attributing, in his work on "Dynamo-Electric Machinery," the invention to Michael Faraday. The plaintiff further claimed that there had been a breach of an agreement entered into in May, 1902, not to insert the passages in question in a forthcoming edition of the defendant's work.

Mr. T. Terrell, K.C., and Mr. Clarkson appeared for the appellant, and Mr. Buckmaster, K.C., for the respondent.

Mr. Terrell read the passages complained of, and said that Prof. Thompson, on having his attention called to the matter, agreed to omit or modify in future editions the passages complained of, and to insert certain other passages which so far as they might have reference to the plaintiff and his invention should be approved by the plaintiff. In June, 1902, the defendant signed and forwarded a revised proof or statement of the passages in question to the effect that the term dynamo-electric machines was originated by the late Mr. Charles Brooke, F.R.S., and its first application was to the machine invented by Dr. Henry Wilde. With the years 1865 and 1867 the era of the dynamo-electric machine was entered upon. The name was first given to the machine invented by Dr. Wilde (meaning the generator of dynamic electricity invented by the appellant). It was to this machine that in 1867 Brooke gave the name of dynamo-electric machine. Prof. Thompson now declined to insert these passages, and in lieu thereof inserted passages in which the plaintiff was deprived of the credit of being the first inventor. Counsel submitted that the passages he complained of amounted to legal libel, because libel meant depriving a man in any way of his reputation. A statement concerning a man of no reputation might be no libel, and yet the same statement about a man of great reputation might be a libel. Here Dr. Wilde, the first to invent dynamo-electric machines—probably one of the most important matters in the development of electricity of modern times—was jealous of his reputation, and said that by attributing this discovery to Prof. Faraday, the defendant was depriving him of his reputation, and that amounted to a libel. The agreement, too, he should have thought was well within the law of contract. It did not matter whether the original claim was well founded or not.

Lord Justice Stirling: It must be a substantial *bond fide* claim.

Mr. Terrell said the parties had agreed to the exact modifications which were to be put in.

Lord Justice Vaughan-Williams: Although you may have instituted proceedings, there must be a forebearing to sue in order to make a good consideration, and if there is no forbearance to sue, you make a complaint. The other man says, good naturedly, in answer to you, "I am sorry you do not like the statement in my book, but I will alter it by putting in such and such words." There is no consideration there. It is merely an expression of a kindly intention. You cannot have a bargain unless both sides are bound to something. There is nothing in the agreement, as set forth in the statement of claim, which prevented Mr. Wilde from suing. He might have commenced his action the very next day.

Mr. Justice Romer: It is obvious that there is no such agreement, but simply a friendly act on the part of the defendant, and the plaintiff did not intend or agree to forego any right whatever.

Mr. Terrell: Supposing the defendant had inserted the paragraphs mentioned, the plaintiff could not have sued him then. The plaintiff would be unable to bring an action, assuming the pleadings to be correct.

Lord Justice Vaughan-Williams: I do not think so. It would have had no practical result, because there would have been no damage.

Mr. Terrell: Supposing I brought the action, would it not be a good pleading on the part of the defendant to have said, "On a certain day you made these complaints, and I agreed to put in a modified statement, and you accepted that in settlement. Therefore I have performed my part and you cannot bring the action."

Lord Justice Vaughan-Williams: If you look at the words set forth in your statement of claim, they do not amount to the statement which you allege in your second claim. In the statement of claim you put a meaning on the words that are used. As I understand, he is of opinion that the words do not mean anything of the sort.

Mr. Terrell: The question of the meaning of the words is, what did they mean having regard to the circumstances existing at the time they were written? That is for a jury.

Lord Justice Romer: Many people in this world think they are the authors of important discoveries. If everyone who writes a book and does not give according to the first man's judgment the fullest merits claimed by him is to be subjected to an action for libel, nobody will ever be able to write a history of science. No inventors are ever agreed as to the extent of their own inventions.

Mr. Terrell submitted that it was an actionable wrong to deprive a man of his reputation, and came within the legal definition of contempt.

Lord Justice Stirling: There is nothing to deprive him of his title of independent inventor. If you searched all Prof. Faraday's records you would find that he knew principles which have been subsequently developed and made the subject of patents, but he never published them. How the fact that the greatest electrical discoverer of the last century knew something prevents another man from independently discovering it, I do not see.

Mr. Terrell: We are alleging, and Dr. Wilde says, he was the first discoverer of the principle of a separately excited dynamo.

Lord Justice Vaughan-Williams: He claims only what the defendant gives him credit for in the book.

Lord Justice Romer: He does not say he discovered the principle that instead of a permanent magnet you could have a magnet excited by electricity. He narrows his claim to a certain principle of an indefinite increase, whatever he means by it, but he does not claim the simple principle.

Mr. Terrell said the principle was not the discovery of the electro-magnet, but the discovery of the fact that given an electro-magnet, starting it with a minute current of electricity, as the machine drove it, it would gradually acquire electricity enough to energetically operate.

Lord Justice Romer: But eliminating this, what is there that you can really complain of?

Mr. Terrell replied that Faraday had not used electro-magnets for this purpose. The fact that you could have an electro-magnet which would attract just like an ordinary magnet was known. He did not suppose Dr. Wilde claimed any credit for that, but for the fact that you could take an electro-magnet which started not as a magnet at all and convert that into a sufficiently powerful magnet—a "separately excited dynamo"—that was to say, a dynamo the magnet of which was excited separately.

Lord Justice Romer: I do not think on this statement of claim that he really thinks he was the first discoverer of that. I do not know why he wants to proceed with the case. I should have thought his reputation did not require the prosecution of such an action as this.

Without calling on counsel for the respondent, Lord Justice V. Williams said the judgment of Mr. Justice Buckley must be affirmed, though in coming to this decision he must not be supposed in any way to be affirming such a proposition as that a person could not be libelled by denying his title to a reputation which he might have obtained as an inventor or a man of science. Nor was it necessary to say that to publish such things of an inventor or a man with a reputation as a scientist necessarily fell outside the old definition of defamation as being something which was calculated to bring the plaintiff into contempt or ridicule. The plaintiff alleged that he was the first discoverer of the principle of the indefinite increase of magnetic and electric forces from quantities indefinitely small, and he did not in any way show that there was anything in the defendant's book which was inconsistent with that portion of the statement of claim. Although they knew that inventors were a very thin-skinned, excitable class, he could not understand even an inventor supposing that there was one word in the defendant's book which in the slightest degree could injure his reputation. On the contrary, passages seemed to recognise in the fullest degree the scientific reputation of this gentleman. With regard to the agreement, there was no suggestion that there was any threat or intention to sue. It must have been a mere conversation in which Prof. Thompson expressed, for the sake of peace, an intention to do that which he found ultimately he could not, according to his view, properly do. It was idle to say there was any agreement which in the slightest degree would have prevented the plaintiff from bringing an action.

Lords Justices Romer and Stirling concurred, and the appeal was dismissed with costs.

Electric Tramways Construction and Maintenance Co., Ltd.

In the Chancery Division of the High Court, Mr. Justice Buckley, sitting for the disposal of company business on Tuesday, had before him a petition by E. Horton and others for the winding up of the Electric Tramways Construction and Maintenance Co, Ltd.

Mr. Kirby, who appeared for E. Horton and others, asked that the petition be dismissed on terms arranged with the company.

Mr. Ashton Cross appeared for the company.

His Lordship assented to the application and dismissed the petition.

CORRESPONDENCE.

[*Letters arriving after first post on Wednesday morning cannot appear until the following week.*]

Wireless Telegraphy.

My attention has been called to your comments on international legislation for wireless telegraphy, which appeared in the issue of September 11th of your valuable publication, in the course of which some strictures on the present efficiency of wireless telegraphy, as exhibited by the Marconi system, are expressed.

The supporters of the Marconi system cannot consistently claim for it in point of efficiency more than it can absolutely demonstrate, and have no desire to deceive anyone, not even themselves, with respect to the stage of development now reached by the system. At the same time, it is but natural that they should desire to protest against misrepresentation of facts, whether inspired by malice or honestly made through lack of exact information.

In the article referred to, you have been pleased to designate the service rendered by the Marconi Wireless Telegraph Co. for the Associated Press during the International Yacht Races a *fiasco*. I believe you have been misinformed as to the character of that service, which, though admittedly interrupted for one day, was considered of value by the Associated Press, and was cheerfully paid for by the Associated Press manager, Melville E. Stone, Esq. It is impossible that anyone so well known as Mr. Stone, or so businesslike as he, would pay for a *fiasco*. In addition, Mr. Stone, in presiding at the annual banquet of the Associated Press, held at the Waldorf-Astoria Hotel on the evening of September 16th, 1903, in explaining the absence of Mr. Marconi, said :—

I had hoped, or, rather, I speak for the Committee of Arrangements, that we should be gratified by the presence to-night of a gentleman who has done so much in the last 10 years for the work in which we are engaged, perhaps, as any man living. I refer to William Marconi, who accepted the invitation of the Committee, but at the last moment was forced by his engagements in Canada to send his regrets, and at the table to-night I received a telegram renewing and emphasising the regret—that work of an important nature deprives him of the pleasure of being present here. I think, perhaps, that your attention has not been called, and it has not been impressed upon you, that less than a month ago I sent him daily, while he was on his way from Liverpool to New York on the *Lucania*, a telegram giving him a budget of the day's news at the close of each day, and each day that budget of news was received, all the way across the broad Atlantic, and each evening was posted in the smoking room of that steamer. (Applause.) It was a triumph of which Marconi could well be proud; and, while wireless telegraphy is not yet an exact science, and while we encountered a good many difficulties during the recent yacht races, I may say to you that the things it did do were marvellous, almost beyond conception.

The conditions under which the service was rendered presented unusual problems in interference. The Associated Press yacht *Chetolah* carried Marconi apparatus, communicating either with the Marconi shore station at Jamaica or Babylon. Another company equipped a tug with its apparatus for communicating with shore stations at Coney Island and Sandy Hook. Still a third company installed very powerful apparatus on a schooner towed about by a tug, the shore stations of this company being at Galilee and Navesink Highlands on the New Jersey coast.

Including Sir Thomas Lipton's yacht *Erin*, which carried wireless apparatus, presumably communicating with Coney Island, there were, in addition to those of the Marconi Co., seven wireless stations in active operation during every race day, within a radius of 30 miles.

The simultaneous operation of nine wireless stations, or even four all within range of each other, with plain aerial, admittedly presents difficulties as the art of wireless telegraphy is known to-day. The difficulties are increased when part of the stations maliciously keep practically closed keys. During the races the tug carrying apparatus of another company was at no time more than a half mile distant from the *Chetolah*, and for a large part of the time not more than a hundred rods. The schooner of the third company with a 10-KW. spark—we are informed—was, through lack of speed, not able to keep so close to the *Chetolah* as the tug.

Notwithstanding these conditions, the Marconi operators successfully and accurately transmitted approximately 70 per cent. of the messages offered by the Associated Press reporter, leaving out of consideration the one day of failure. This service was rendered during the seven race days. The percentage of words accurately transmitted was considerably higher. The official records of the Associated Press will verify these statements.

I respectfully submit that in view of the record above presented, which is susceptible of legal proof, that the "vaunted pretensions to syntony of the Marconi system" are not falsely vaunted, and syntonic operation is of value even in the event of fierce and malicious interference. It is true that in its present stage of efficiency, it may be "pestered" by hostile installations located almost within reach of hand; but the same disturbing agencies would pester any known cable or wire system to as great an extent under similar circumstances. In the possession of a group of companies harmoniously co-operating like the cable companies, the syntonic system even now furnishes a closer solution of the problem of interference than the tenour of your article would indicate you admit.

W. H. Bentley,
Marconi Wireless Telegraph Co. of America.

New York, *October 6th*, 1903.

I have read the foregoing, and cheerfully attest its accuracy.

Melville E. Stone,
General Manager, Associated Press.

New York, *October 6th*, 1903.

[The letters we publish to-day, one from Mr. W. H. Bentley, of the Marconi Wireless Telegraph Co. of America, and another from Mr. Melville E. Stone, general manager of the Associated Press of New York, in criticism of our article of September 11th, exhibit a degree of mildness rare in the official statements of wireless companies. We can only express regret that this moderation, manifested as it is side by side with a straightforward confession of the inadequacy of the system, did not characterise the utterances of Mr. Marconi and of his representatives before, rather than after, the crucial tests were applied; and before, rather than after, the public put their money into the business.

The charges these letters bring against the ELECTRICAL REVIEW are that we described the Yacht Race wireless system as a *fiasco*, and that we referred to "the vaunted pretensions to syntony of the Marconi system." As regards the justness or otherwise of our use of the term *fiasco*, we will say that if there is any word that more truthfully expresses the confusion of messages, so picturesquely suggested by Mr. Bentley in his letter, we will gladly make him a present of *fiasco*. But we deny that by the use of the word *fiasco* we in the slightest degree misrepresented the facts. By Mr. Bentley's own showing, there was complete interruption for a whole day; and, as regards the quality of the work done on other days, only about 70 per cent. of the messages handed in were successfully and accurately transmitted. In ordinary telegraphy such a performance would be denounced as an absolute failure.

With sorrow we have to confess that our use of the phrase "the vaunted pretensions to syntony of the Marconi system" is fully justified by the statements reported to have been made by Mr. Marconi and his representatives. We turn to the pages of the *Times*—that same *Times*, whose system of Marconigrams ended in another *fiasco*. In the *Times* report, of June 14th, 1902, of his lecture at the Royal Institution, Mr. Marconi is represented thus:—"In describing the apparatus employed, he remarked that it was now possible to establish a considerable number of wireless telegraph stations simultaneously in the vicinity of each other without the messages suffering any interference." Was not this a vaunted pretension to syntony? The report continues:—"He pointed out, however, that a powerful transmitter giving off waves actuated near one of the receiving stations might prevent the reception of messages to some extent." But are we to suppose that the practical conditions referred to by Mr. Bentley, of, at the most, nine wireless stations in active operation within a radius of 30 miles, are the equivalent of a powerful transmitter actuated near one of the receiving stations? And is a whole day's failure to be interpreted as an interruption "to some extent"? Again, in an interview reported in the *St. James's Gazette*, February 9th, 1903, we read:—"Do you say then, Mr. Marconi, that you can confine the currents?" The reply he is reported to have given is:—"Not exactly confine them; but I can tune my instruments so that no other instrument that is not similarly tuned can tap my messages. I did this in the Atlantic messages." What are we to say of such reports when we bring them side by side with the picture presented to us by the letters we print to-day? If any one further doubts the rectitude of our description of the "vaunted pretensions to syntony" let him read the official narrative of the combined manœuvres of the Mediterranean, Channel, and Cruiser Squadrons in 1902. The Commander of H.M.S. *Pegasus*, for example, at a critical moment found that it was "impossible to get any signals through by wireless telegraphy, which was being completely blocked by the escaping ships." In sight of the escaping battle squadron, visual signalling had to be resorted to "as the escaping ships were successfully obstructing all wireless telegraph work." Where was the vaunted syntony? Or going to another source altogether, let us turn to the *Journal of the Society of Arts* and read the report of Mr. Marconi's lecture delivered as far back as May 17th, 1901. He then said that his efforts to secure syntony were "crowned with complete success." When it is remembered that such statements as this have considerable influence with the investing public, we think our readers will agree that our strictures were fair and moderate.—EDS. ELEC. REV.]

Jointless-Section Induction Coils.

With reference to Mr. Hadfield's letter in your last week's issue, I have just learnt that the winding of the coil in question was roughly held down on to the paper discs with string, or sewed on with thread. No wonder it broke down! No patent for the winding has ever been applied for, or a word published on the subject, so far as I can learn, in England, and I went out of my way during the two months when the patent could have been opposed to call the attention of the agent of a firm claiming to have made similar coils to his opportunity if he had anything to bring against the grant. The fact is, the winding, if really used, has been kept a trade secret. How my patent will be affected I do not know, but at any rate, there has been no anticipation of my claim on the necessary machine to carry it out. In the same way that a well-insulated wire must always be superior to one badly insulated, the new winding is better than the old, and must come into universal use. Coils on both systems can be badly designed. Having held my own against foreign competition with the inferior type, without any patent, I do not expect to need any Chamberlain tariff to continue to do the same with the new.

Leslie Miller.

London, *October 28th*, 1903.

Electro-Galvanising.

As a constant reader of your paper, would you kindly inform me what has been done in this country or abroad as regards electro-galvanising? Can you give the names of makers of the plant? How does the cost compare with the ordinary dipping process? Can it be applied to small articles in large numbers? Any information on the subject would be of considerable value to me.

W. Z.

[See article in the Electrical Review, May 23rd, 1902, p. 871. Probably the Cowper-Coles Galvanising Syndicate, Ltd., of Grosvenor Mansions, Victoria Street, S.W., could assist our correspondent.—Eds. Elec. Rev.]

An Interesting Letter.

We have noticed from time to time that you have articles in your paper dealing with Mr. —— and his productions, and perhaps the enclosed letter, which has been forwarded to us, will be of interest to you.

We would particularly draw your attention to the portion we have underlined, which we trust is not the usual method adopted by Mr. —— to push business.

Consulting Engineers.

Messrs. ————,
Consulting Engineers.

Gentlemen:—I beg to enclose descriptions of trolley tramways and trackless trolley traction without overhead equipment, bonding and boosting cables, *and beg to say if you will specify these systems I could allow you several times more than you receive for other systems.*

Yours truly,

————.

Single-phase Alternating Current Motors.

In reply to Mr. Fynn's letter in your issue of October 23rd, I beg to point out that, in his letters appearing in your issues of October 28th and December 12th, 1902, he simply states that he has invented a high starting torque single-phase motor, which, when tested, has given excellent results. No description of the motor is given in these letters, nor is the working principle or the new features in the design explained. It is therefore impossible for me to find out whether Mr. Fynn is correct in stating that "all novel features claimed for my machine were embodied in the motor alluded to in his letters," and I think it would only be fair for Mr. Fynn to give some proof of his claim. I have looked up the patents taken out by Mr. Fynn for single-phase motors, and find that three specifications have been filed by him, viz., Nos. 20,571 and 20,572, dated September 20th, 1902, and No. 22,712, dated October 18th, 1902. I have only been able to see the first two specifications, and find that the subject of these is entirely different to the improvement covered by my patent. Specification No. 22,712 was not obtainable in the Manchester Patent Library, but as this specification is dated 10 days later than the one of my own patent, it would be null and void if it really covers the same invention. I might mention that the application for my German patent was filed on May 22nd, 1902.

L. Schüler.

Waste of Energy in Tendering.

I read with considerable interest Mr. E. K. Scott's notes on the above subject, which certainly has the undivided attention of all electrical, manufacturing and contracting firms; but there, unfortunately, the matter ends!

It is undoubtedly true that useless tendering involves an amount of brain work which is a loss to the profession; but what remedy can Mr. Scott suggest? I, personally, do not believe in the killing off of a few smaller concerns, and even if this should take place, new ones will most assuredly crop up again in the place of the old ones, the result being a *status quo ante*.

Some years ago this subject was approached, and dealt with by the Institution of Electrical Engineers of a country on the Continent, and it was suggested that all electrical firms should agree not to estimate for a plant of any kind gratuitously, but should in case of having tendered unsuccessfully receive a certain remuneration, the amount of which was to be proportionate to the value of the plant estimated for. What would be the result of such measures? At first, certainly, the amount of work brought about by each inquiry would be less, for the simple reason that these inquiries would be sent to a few firms only, as the customer would strive to keep expenses for estimates as low as possible. The inquiries would therefore go to the larger firms only. The smaller concerns would be able to reduce the staff of their estimating department, but, I am afraid, very soon their works staff also. It is for reasons such as these that the firms concerned at the time came to no understanding on this matter. Here, it should not be overlooked that the estimating department of a Continental electrical firm turns out infinitely more work than that of the English concerns, as the contractors on the Continent are generally also the consulting engineers for the plant they are estimating for.

A proposal was also brought forward to institute a kind of Central Estimating Bureau, the expenses of which would be defrayed by all the firms interested, for whom this Central Estimating Department got out the schedules of tenders, which were then sent to each individual firm for the prices to be filled in. It is obvious that this system has also many drawbacks and can hardly be carried out in practice when two or more firms are competing against each other.

I have several times given the matter referred to by Mr. Scott very close attention, but have always failed to solve the difficulty. It would be interesting to hear the opinions of other members of the profession.

Arthur Bloemendal.

London, *October 26th*, 1903.

Smoke Abatement.

I have just seen Mr. Daniell's reply to my letter on the above subject, and regret that he has misunderstood both the motive for it, and the description of the furnace contained therein.

If he will take the trouble to properly read it, he will see that in the description, I stated, *re* the air distribution, "finally ejecting it partly in the ash-pit, and the remainder through series of jets placed at the back of the bridge, where it unites with the volatile gases, completing their combustion."

Further on, again, I referred to this most important point, which his reply only enlarges upon and emphasises.

I can only say in conclusion that I entirely agree with the remainder of his letter, and regret that he did not consider the unnecessary trouble caused by attempting to reply to a letter before having first digested its contents.

H. H. B. Deane.

Birmingham, *October 26th*, 1903.

The Central Station Battery.

No doubt Mr. Abraham has by this time found many uses for the cell recorder that he so recently patented, and of which he gave such a glowing account in the ELECTRICAL REVIEW for September 18th.

It was, however, only in the next issue that the observant reader found on page 524 the following :—19,319. "A cell recorder for use in electric light stations and other places." A. J. Abraham. September 8th.

Batteries are at the present time undoubtedly neglected, but I am afraid that Mr. Abraham's article is calculated to do much more harm than good.

Anyone on reading his article would at once jump to the conclusion that they had only to buy one of his patent cell recorders and take the volts of their battery once a week, marking all those low below 1·8, and high above 2·5. Apparently they would then have done their duty, and the battery would require no further attention.

Mr. Vicarey in your last issue goes a step further, and advocates specific gravity readings, and at the same time does not discriminate between the E.M.F. and the P.D. of a cell.

Specific gravity readings by themselves are almost as useless as volt readings, as there are many things to be taken into account. The variation due to evaporation of the electrolyte is often very considerable, especially as in many cases it is allowed to get below the tops of the plates. Secondly, the cells may not have been fully charged on the particular day the readings were taken ; and, thirdly, the variation in the temperature of the electrolyte. The reader will at once see that it is not so easy to compare the readings as Mr. Vicarey leads one to believe. Mr. Vicarey further states that "even a partially short-circuited cell will sometimes give its normal E.M.F. while charging." Now the normal E.M.F. of a cell is about 2 volts, but the P.D. of the cell at the end of charge should be from 2·55 to 2·75 volts, whilst one only showing 2 volts would probably be very badly short-circuited.

Mr. Abraham's cell tester appears to me to be unreliable for the purpose, as if one cannot trust a man to write the figures down correctly, he certainly cannot be trusted to press a key, the reading of which may or may not correspond with the reading on the voltmeter. As it is usual to take volt readings on the weekly over-charge day, I cannot see how it is going to save current ; this extra current is not going to waste as Mr. Abraham imagines, but is causing important chemical changes to take place in the cell, of the nature of which he probably has little conception.

Weekly volt and specific gravity readings are important only as a record and as a check by the engineer or battery maker on the battery attendant ; the way, however, to keep a battery in order is to do what Mr. Abraham evidently so contemptuously ignores. He says, in his article, that cells are "just looked at to make sure they are gassing."

This, one might say, is the whole secret of the business ; go round the battery at the end of every charge and see that all the cells gas up equally and simultaneously. If any are backward there is a cause, and they should be immediately examined, and, if necessary, milked-up. Last, but not least, do not let the cells gas too long ; and, I think, if Mr. Abraham does this he will be able to put his recorder on the scrap heap instead of his battery, and thus get a higher efficiency, at any rate, financially.

Electrolyte.

[MUNICIPAL TYRANNY.—We received, some days ago, a letter from a provincial correspondent on the subject of Mr. Metzger's relations with the Manchester Electricity Committee, but as it contains charges of a personal nature, and our correspondent declines to allow his signature to appear with the letter, we have no alternative but to withhold it from publication.—EDS. ELEC. REV.]

Insulating Paper.—We have received from Messrs. Johnson & Phillips's electric cable department a specimen disc of their standard "pure Manilla" paper, such as is used on their cables made to the Post Office and other standard specifications.

BUSINESS NOTES.

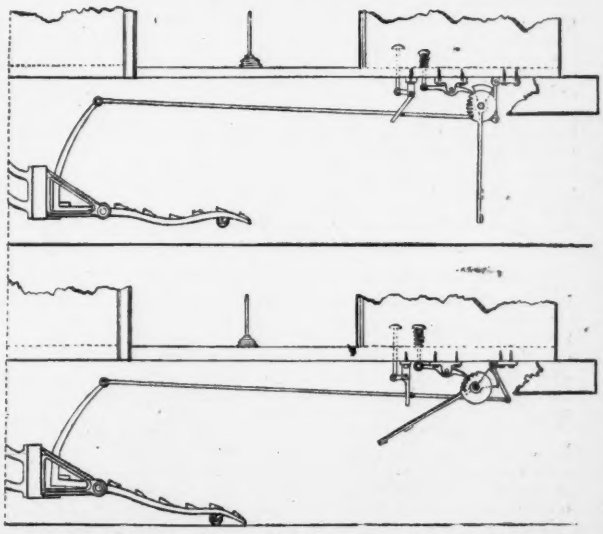
Electrical Wares Exported.

WEEK ENDING OCT. 28TH, 1902.		WEEK ENDING OCT. 27TH, 1903.	
Alexandria	Value £311	Alexandria	Value £35
Amsterdam	161	Amsterdam	90
Auckland	432	Auckland	75
Bombay	724	Bahia. Teleg. mat.	9,618
Buenos Ayres	397	Beira	162
" Teleg. cable	1,564	" Teleg. mat.	99
" Teleg. mat.	270	Bombay	550
Calcutta	450	" Teleg. mat.	80
Cape Town	309	Boulogne	55
Channel Islands	42	Buenos Ayres	32
Christiania. Teleg. wire	11	" Teleph. appar.	453
Cologne	45	Calcutta	950
Colombo	42	Cape Town	3,552
Durban	3,771	" Teleg. mat.	951
East London	225	Channel Islands	502
Flushing	10	Copenhagen. Teleg. cable	52
" Ship's teleg.	55	Delagoa Bay. Teleg. mat.	215
Fremantle	24	Durban	887
Gibraltar	26	" Teleg. mat.	170
Hamburg	105	East London	826
Hong Kong	150	Hamburg. Teleg. mat.	250
Liban	67	Kure. Elec. machinery	97
Melbourne	334	Launceston	95
Ostend	41	Lisbon	54
Perth	17	Melbourne	357
Port Elizabeth	1,284	" Teleg. mat.	152
Rotterdam. Teleg. mat.	280	Montreal	24
Shanghai	818	Nagasaki. 1 knot s'bm'rine cable	—
Sydney	18	New York	22
Wellington	1,075	Perth	337
		Port Elizabeth	94
		" Teleg. mat.	798
		Port Said	99
		" Elec. cable	659
		Rio de Janeiro	10
		Rosario. Teleg. mat.	774
		St. Lucia	22
		St. Petersburg. Teleg. wire	59
		Santos	14
		Shanghai	224
		Singapore	101
		Sydney	2,468
		" Teleg. mat.	90
		Wellington	294
		" Teleg. mat.	2,423
		Yokohama	526
Total £13,008		Total £29,397	

Foreign Goods Transhipped.

New York. Elec. goods Value £70 | Sydney. Elec. lamps .. Value £100

The Newton Tramcar Life Guard.—On the 16th inst. there took place at Southport a trial of an improved type of life-guard attached to one of the Corporation cars. This is the invention of Mr. D. Newton, of Southport. The advantages claimed for the "Newton" improved patent lifeguard over existing ones now in use are :—(1) The platform or guard works loose on its pivots and is retained in its position by counter-balancing weights only. (2) The guard works in conjunction with, and independently of, the gate. (3) The guard is drawn down by the gate through the medium of the cam and lever. (4) The guard is under direct control of the motorman, who can bring it down and return it to its position at will. (5) A ratchet wheel and pawl arrangement by which the gate and guard are locked. (6) The ease and comfort with which the



NEWTON LIFE GUARD. 1.—NORMAL POSITION ; 2.—IN ACTION.

motorman can replace the guard in position again. (7) The guard coming down upon the rails will run smoothly along by means of the rollers, and any object picked up by it would be retained. (8) The guard always maintains its horizontal position, and is therefore not liable to be broken ; if jolted from its seating it returns unaided, consequently not taking the attention of the motorman from his other duties. (9) The guard can be placed in operation in three ways, either separately or in conjunction with each other. (10) Last, but not least, there are no

springs to get out of order. These, by constantly tugging at the guard, bring the front edge nearer and closer to the ground, so that if a car is overloaded the guard is frequently broken. The operation of the guard will be clearly gathered from the diagram; we understand that it has received the provisional approval of the Board of Trade.

The Late Fire Congress.—We have been favoured with a copy of the official edition of the proceedings of the First International Fire Prevention Congress, which our readers will remember was held in July (from 6th to 9th) in London. It is published by the *Public Health Engineer*, of 50 52, Ludgate Hill, E.C., that journal having been entrusted with the responsibilities of Official Recorder. The book is not the sort of thing to take up and read through as one would do a novel; it is essentially a record, and as such possesses considerable value as a work of reference containing the views of the leading authorities of this and other countries in regard to the many perplexing problems which are for ever arising in connection with the very wide subject of fire prevention. The preparation of the record has necessarily involved much labour and pains in its preparation, and as one example of the sort of thing that has helped to make that so, it may be mentioned that the discussions were carried on in several languages, but they appear in the report in English. The edition is published in English, but an appendix of papers presented in French and German has been produced for circulation abroad. The electrical papers, which are printed with their discussions, are:—"Safety and Control Arrangements of Fire Alarms," by Alex. Siemens; "The Necessity of Automatic Fire Alarm Systems with Direct Brigade Communication," by G. H. Oatway; "Electrical Risks in Theatres," by Hip. Cazier, of Créil; "Necessary Practical Safeguards Against Lightning," by Alfred Hands (this paper is fully illustrated); "Electric Wiring and Electric Risks," by E. C. de Segundo. As a collection of up-to-date and authoritative views on fire prevention matters, we should think that this volume is as complete as anything that has so far appeared. The price of the publication is 20s. net.

"Antifrix" Packing.—We have received from Messrs. Boardman Bros., of Victory Works, Jordan Street, Knott Mill, Manchester, some samples of this packing. It is composed of pure Italian asbestos yarn, combined with anti-friction metal with a melting point certified to be 371° C., or nearly 700° F. This is solutioned together and blocked under a pressure of 3½ tons, and then vulcanised by a special process to render the packing absolutely steam and waterproof. It is not affected by either heat or cold, and consequently cannot set hard when in store. It is said that neither water, steam nor oil will make any impression upon it, and it will not break up or fray. It will not score or flute the rods, as the metal employed in making it is softer than any rod of an engine. Owing to the very high melting point, the makers claim that it cannot be dissolved in any steam pressure so far obtained in any engine, whether with superheated or wet steam, and, consequently, it will last well. It is specially suitable for high pressure work, whether with steam engines, electrical machinery, or triple-expansion engines on steamers, or for mining machinery. There is no tallow whatever in the "Antifrix" packing, and nothing that can possibly decompose, and it is stated that it will withstand any pressure.

Oil Separators.—"The Baker Oil Separator" is the title of a little pamphlet descriptive of the oil separator of the Baker's Patent Appliances Co., Ltd., Scarborough, which depends for its action upon the cohesion of a series of sharply corrugated plates with the oily particles in the passing steam. It is claimed that these separators will separate oil down to a very small fraction. The principle of operation appears to be the division of the stream of exhaust steam into very numerous thin films by means of the above corrugated baffle plates. In passing through the narrow spaces between the plates each particle of greasy water appears to make contact with the greasy plates which pick up the oil and allow it to drain to a point whence it can be removed. No words are needed to emphasise the undesirable results which may accrue from grease in a steam boiler, especially where there is carbonate of magnesia in the feed-water, since this salt forms a most undesirable and dangerous compound with grease, and may cause serious burning of tubes and collapses of furnace crowns.

Catalogues and Lists.—Messrs. Holden & Brooke, Ltd., of Manchester, have now published a complete catalogue of their steam plant specialities. It is a very fine production with handy thumb index to the different sections, and in the course of 220 pages some 190 well executed illustrations appear of their ejectors, feed heaters, steam dryers, oil separators, steam traps and pumps, and so on. Any steam user can obtain a copy by dropping a line to Sirius Works, West Gorton.

A new pocket list has been brought out by Psychiloid, Ltd., of Love Street, Sheffield, giving prices and particulars of their Psychiloid sheeting, tubing, insulating handles, formers for multipolar machines, bobbins and commutator rings. Brief notes from tests made upon the material used as an electrical insulator are quoted.

Messrs. Babcock & Wilcox, Ltd., owing to the large number of orders received from municipalities and others for complete installations of steam and feed pipes, have increased this department at their works, and this will enable them to give quicker deliveries. Up to 10 in. in diameter they are supplying steam pipes of solid drawn steel. They have placed before us a pamphlet with line and other drawings of their steam, exhaust, and feed pipes, which have been extensively used, especially in electricity generating stations. They have further drawn up and issued a list giving the relative evaporations for certain sizes of Lancashire boilers and those of their own type, together with the space occupied.

Messrs. Griffiths Bros. & Co., of Bermondsey, have sent us a priced list of their "Driorol" quick-drying enamel, which they claim dries rapidly even over oily and greasy surfaces, and is suitable for all metal and wood work, and dries with a thin, fine, hard, elastic and glossy surface. It has been used by leading railways for years past.

Messrs. D. Hulett & Co., Ltd., of 55 and 56, High Holborn, W.C., have issued a priced illustrated circular of their steel conduit tubes and fittings for electric wiring.

Messrs. J. H. Holmes & Co., of Newcastle-on-Tyne, are circulating a supplementary list, showing some of the motor contracts booked by them for printing establishments since the issue of their April list of 1,300 motors. The recent orders include one from the Bank of England for 27 motors, aggregating 60½ B.H.P., and one motor of 120 B.H.P. for the *Morning Post*. Holmes-Clatworthy equipments have been supplied for a number of papers, including four sets for Hoe machines at the *Daily Mail* offices.

A 46-page catalogue with excellent art paper and printing, which combine to produce a most effective result, has been brought out by Messrs. C. Redman & Sons, and it shows a number of the high-grade machine tools, such as are manufactured at their Pioneer Iron Works, Halifax. Some of the larger photographs illustrate the erecting shops, a group of automatic machines in service, and a group of planers; these are followed with descriptive particulars and first-class photo-process blocks of individual machines such as planing, shaping, drilling machines, double and treble-geared lathes, &c.

Messrs. David Bridge & Co., of Castleton Iron Works, Castleton, Manchester, have a variety of lists in circulation at the present time. Some of them are devoted to Heywood & Bridge's patent friction clutches, of which large numbers have been supplied for light and heavy drives, its use for dynamo driving purposes being specially mentioned; another deals with the "Baker" oil separator, steam dryer, and steam cleanser; another illustrates and describes their ice-crushing machinery, pulley blocks, enclosed electric motors from ¼ to 7½ B.H.P.; yet another gives tabulated prices of the 'Mercury" hard paper rim pulley; last of all, we may mention a 96-page catalogue, giving many fair-sized engravings of machinery supplied for india-rubber and gutta-percha manufacture. Views of the works are followed by illustrations of mixing, washing, immersing and refining, calendering, doubling, spreading, sheet-cutting, wire-coiling and various other machines used in rubber and gutta-percha manufacture.

A new edition of their general catalogue of their famous economiser has been issued by Messrs. E. Green & Son, Ltd., of Wakefield. It is an excellent production with manifold art illustrations and other detailed drawings; power station engineers, and, indeed, all who are actively engaged in the design and equipment of power generating stations, will peruse it with interest and afterwards file it in an easily get-at-able place. The pictures include a number of typical interior and exterior views of the extensive works at Wakefield which are devoted exclusively to the firm's specialities, *i.e.*, economisers, air heaters, boiler-feed pumps, and small economiser engines. The works cover nearly 20 acres, and employ about 1,000 men. The increasing demand for the Green economiser has necessitated a reorganisation of the business, and this has included the reconstruction of the works plant, the introduction of new special tools and labour-saving devices, and the arrangement of additional facilities for speedily and effectively handling materials, &c. The letterpress in this new catalogue details once more the value and advantages obtained from the use of economisers; gives many sectional illustrations showing parts, tabulated dimensions and capacities; a simple method for taking the chill off feed-water is described. Several pages are labelled "electric section," and give records of certain performances. Some useful outline drawings show the arrangement of several sizes of economiser and their application for stated boiler plants.

The Western Electric Co., of Queen Victoria Street, E.C., has just brought out a new and neatly set-out illustrated catalogue of telephone installations for electric traction systems. The contents include street sets for fitting on the side of feeder pillars, portable sets for fitting inside cars, central station and sub-station wall sets, desk instruments, central battery boards for up to 25 lines, various kinds of protective fuses, protectors and lightning arresters, and many small apparatus and details. Some appropriate wiring diagrams occupy the last 10 pages.

The Keighley Electrical Engineering Co., of Vulcan Works, Keighley, have issued a new catalogue and price list of their dynamos, motors and motor starting switches. A full specification and efficiency curves of the machines are followed with a table of motor sizes, speeds and prices, also a similar dynamo table. The E.P.D. and worm geared starters, also motor switch and starter panels are well illustrated and briefly described.

Messrs. Sperryn & Co., Ltd., of Hospital Street Works, Birmingham, who have a new electrical catalogue in the printers' hands, have sent us a print of a switchboard equipped with a number of their new patent high-voltage main switches, ranging from 50 to 350 amperes.

From the Hyde Electrical Manufacturing Co., Ltd., of Hyde, Manchester, there has come to hand a catalogue of their standard continuous-current four-pole motors of open, protected and enclosed types. A table of dimensions leads the way to a general description and price and output table. Speeds, code words, reference numbers, prices and so on are conveniently shown. The special features of these motors are their all-steel carcase, with laminated-pole shoes, securing a high magnetic density in air-gap, and a total magnetic flux much beyond that obtained in the ordinary commercial machine, thus considerably extending the commutating limit. We understand that special attention has been paid to the ventilation of the field coils, as well as the armature, ventilating ducts being provided through the pole and external casing, in

line with suitably shaped vanes mounted in a corresponding duct in the armature core.

Messrs. Bergtheil & Young, of Camomile Street, E.C., have hit upon a strikingly effective idea for bringing home to newspaper proprietors and electrical engineering contractors the large amount of work that has been carried out by them in the equipment of newspaper offices with motor-driving. The title pages of a great number of newspapers and magazines have been reproduced in small form and bound together, and it is pointed out that all of these publications are regularly produced upon presses electrically equipped by the firm.

Another leaflet issued by Messrs. Bergtheil & Young discusses organ blowing by electricity, and a list is given of a number of cathedrals and churches where organs have been equipped by the firm.

A circular giving prices of electric light carbons, and a list of carbon brushes, have come to hand from Messrs. Moesch & Schmidt, of 43, Basinghall Street, E.C., who are the representatives in this country of J. A. Berne, of Paris.

Messrs. H. Cecil Hodges & Co., of 52, Queen Victoria Street, E.C., have sent us a copy of their sheet No. 5 illustrating their instruments and switchboards of which they are making a special feature, having fitted up extensive works for more rapidly conducting their manufacture. The firm are giving particular attention to central station and other switchboards, distribution boards, high tension switches and fuses in cast-iron cases, &c. Mr. James Gray, of 19, Waterloo Street, Glasgow, is the firm's sole agent for Scotland, Messrs. Dixon & Son, Imperial Buildings, Westgate Road, Newcastle, for Newcastle and the Tyne district, and numerous other agents are appointed for various parts of England.

Plant for Sale.—Blackpool Electricity and Tramway Committee is offering for sale one each 50 and 60-kw. rope-driven alternators with Fowler horizontal engines; one 50-kw. turbo-alternator; and three direct current motors. See our "Official Notices" to-day.

The Transvaal's Imports of Electric Wire and Fittings.—The value of the imports of electric cables, wire and fittings into the Transvaal during the seven months ending with July last is officially returned at £43,000, as compared with £20,000 in the corresponding seven months of 1902.

Imports of Foreign Electrical Apparatus.—The largest monthly total of imports of foreign electrical goods and apparatus into this country so far this year was recorded in September, with £85,676, this comparing with only £78,407 in August last and £49,588 in September, 1902. For the first nine months of the current year the imports have reached a sum of £585,483, which contrasts with only £514,255 in the corresponding period of last year.

May-Oatway Fire Appliances.—The directors of the May-Oatway Fire Appliances, Ltd., in their second annual report, are able to show a net profit, the company having now turned the corner. Some large installations have been carried out during the year, and the turnover has been quadrupled.

Trade Announcements.—Mr. H. Willoughby Lance, who has been connected with the Islington Electricity Works for the past seven years—for the last three in the capacity of senior electrician on mains—has acquired the electrical contracting business of Edward Leach, at Llandudno, with the sole agency for the district for the Brush Co.'s incandescent lamps. He has also been appointed agent for North Wales for Messrs. Fielding & Platt, gas and oil engine, &c., makers. Previous to his work at Islington, Mr. Lance was with the General Electric Co. and the Brush Electrical Engineering Co.

Mr. R. G. Mercer, A.M.I.E.E., who has been with the British Insulated and Helsby Cables, Ltd., Prescot, for the last five years as outdoor superintendent, has been appointed as manager in Messrs. Psychiloid, Ltd., electrical insulating works, Sheffield.

The Rhenish Rubber and Celluloid Co., Ltd., have removed their showrooms and offices to 68, Basinghall Street, E.C.

"The Phielashok" (Oliver's Patent).—Messrs. Oliver & Co., arc lamp manufacturers, have introduced a new electrical instrument or appliance in the form of an ordinary flat pocket pencil case, which they appropriately call a "Phielashok." This instrument is for testing electric wires and apparatus to ascertain whether they are alive, and it owes its introduction to the high-pressure of electric supply now prevailing in this country. A frequent test for electrification is by placing the body directly across the part in question, and the supposed other pole of the circuit, when a shock of either 230 or 460 volts may be expected. The "Phielashok" consists of an outer metal case, and an inner sliding portion specially prepared of very low electrical conductivity material, which is capped with metal. In making a test it is necessary to hold the metal case in one hand with the slide drawn out a certain distance, to place the other hand to one pole of the circuit, and to touch the supposed other pole with the metallic end of the slider. Thus, the body will be placed in series with the low conductivity slider, probably directly across the supply voltage, and if so a very slight shock will be experienced, giving an indication to the user that the wire or part is alive. Although the advantageous uses of this device may be many, its indiscriminate use on earthed systems may be attended with considerable risk, unless a "Phielashok" is used in each hand.

For Sale.—The Northwich Electric Supply Co. is inviting offers for 36 two-wire 220-volt and 18 three-wire 440-volt Aron wattmeters. See our advertisement pages to-day.

Schuckert Contracts.—The British Schuckert Electric Co., Ltd., have recently received the following orders, among others:—For Paisley Corporation, extensions to tramway switchboard, consisting of nine panels, with the necessary instruments and switch-gear; also a negative booster set of 27 kw. capacity, to work in conjunction with the return current feeders. For the Dunlop Rubber Co., Ltd., Aston, through Messrs. Willans & Robinson, who are supplying the engine, a 275-kw. direct current generator, 250 volts, 340 revolutions per minute. This machine will operate in conjunction with the existing plant of the Dunlop Rubber Co., the whole of which, including generators, motors, &c., was installed by the British Schuckert Electric Co., Ltd. For the Lurgan Weaving Co., Belfast, an 88½-kw. combined direct-current generator, 220 volts, and Allen steam engine, together with ejector condensing plant complete.

Ferranti, Ltd.—A statement has been issued by Messrs. A. W. Tait and A. Whittaker, the joint receivers and managers, giving an approximate balance-sheet at September 2nd, 1903. The liabilities, shares, debentures, banker's loans and creditors are £413,597; the assets, as valued in the company's own books, stand at £15,524 short of this amount.

Books Received.—"Fowler's Mechanical Engineers' Pocket Book." Manchester: The Scientific Publishing Co.

"Cours D'Electricité," par H. Pellat, Vol. 2. Paris: Gauthier-Villars, Imprimeur-Librarie. 1903.

"Notes on Material, Construction, and Design of Land Boilers," by Edward G. Hillier. London: Taylor, Garnett, Evans & Co., Ltd., and The National Boiler and General Insurance Co., Ltd. 1s.

"Notes on Electric Railway Economics and Preliminary Engineering," by W. C. Gotshall. New York: McGraw Publishing Co. 1903.

"Designing Ironwork," Second Series, Part IV., by H. Adams, 60, Queen Victoria Street, E.C. 2s.

Dissolutions and Liquidations.—In the High Court of Justice, Chancery Division, on the 27th inst., before Mr. Justice Buckley, the voluntary winding-up of George F. Milnes & Co., Ltd., was continued under the supervision of the Court, the receiver in the debenture-holders' action being appointed as additional liquidator.

Creditors of the Yorkshire Electric Power Syndicate must send particulars of their debts, &c., to the liquidator, Mr. J. W. Close, 7, Greek Street, Leeds, by November 21st.

The last day for receiving proofs for intended dividends in the case of Harry South & Co., Ltd., Garrick Street, W.C., is November 7th. Mr. H. H. Hilton, 7, Lothbury, E.C., liquidator.

ELECTRIC LIGHT AND POWER NOTES.

Arbroath.—The Special Committee has recommended the T.C. to accept the offer of the Empire Electric Light and Power Co. for the lighting of the burgh. It is stated that the company intend to take over the prov. order acquired by the Council, and complete the scheme within twelve months.

Bangalore.—It is proposed to utilise the surplus power of the electrical installation at the Cauvery Falls for lighting the cantonment.

Barry.—Notice of an application to the B. of T. for amendment of the Barry Electric Lighting Order, 1901, appears in the *London Gazette* for October 23rd.

Bath.—The R.D.C. has resolved to make further application to the B. of T. for a prov. order embodying the whole of their district.

Bedwellty Pits.—The Tredegar D.C. has decided to light the village of Bedwellty Pits with electric light supplied by the Tredegar Iron and Coal Co. at 4d. per unit.

Bognor.—The U.D.C. has adopted the scheme of the Industrial Engineering Co. for installing the electric light into the town. By the scheme the company will lease the Council's order for 21 years, with perpetual extensions of seven years, and find the capital and plant. The maximum rates for the supply of energy will be 4½d. per unit for private lighting, 2½d. per unit for public lighting, and 1½d. per unit for power. It is hoped to have the supply ready by July next.

Bolton.—The Corporation Electricity Committee has resolved to apply to the B. of T. for permission to generate and transmit electric energy at a higher pressure.

Bombay.—A discussion has arisen as to the voltage of supply for the electric light in the city, which the Brush Electrical Engineering Co. is about to instal. It is asserted locally that the voltage should not be higher than 200, owing to the dampness of the atmosphere in the district, whereas the company wish to supply energy at 230 volts. It has, accordingly, been recommended that the Corporation inform the Government, that the former has been advised that a higher voltage than 200 for general lighting work is unsuitable to the local atmospheric conditions of Bombay, but that, if the Government is advised by its experts that a voltage of 230 would not be too high, the Corporation will have no objection to that voltage being sanctioned.

Bristol.—The Corporation Electricity Committee has adopted a scheme for free wiring and hiring out motors on the hire-purchase system. The free wiring will be carried out through local contractors.

Calne.—The Southern District Electricity Corporation has informed the T.C. that it intends to apply to the B. of T. for a prov. order for the lighting of the town, and the T.C. has replied that it cannot uphold the corporation's decision as it is contemplating making a similar application.

Caterham.—The Urban Electricity Supply Co. is now supplying energy for public lighting from its new generating station recently erected. The plant comprises two G.E.C. dynamos of 44 KW. each, connected to Belliss & Morcom engines of 70 B H.P. The U.D.C. has the option of purchasing the undertaking after a certain period.

East Molesey.—Messrs. Edmundson's Electric Lighting Corporation has received the consent of the U.D.C. to obtain a prov. order for the lighting of the town, and has fixed the prices for the supply of energy as follows:—Private lighting, 7d. per B.T.U. for the first hour per day on the maximum demand, and 3d. per unit afterwards; public lighting at 2½d. per unit.

Germany.—The municipal authorities of Bonndorf have decided on the establishment of a central electric lighting station in the town at an estimated cost of £7,500.

Gillingham (Dorset).—The P.C. has appointed experts to go into the question of installing the electric light in the town, and to prepare a scheme. It is proposed to utilise the water at a disused mill for driving the machinery, and the cost of energy is put at 5d. per unit.

Grantham.—The generating plant at the Urban Electric Supply Co.'s electricity works, recently opened, comprises two Belliss & Morcom compound engines of 136-H.P. each direct coupled to Parker dynamos. Steam is derived from two Hornsby water-tube boilers, fitted with Mildrum's stokers and their forced draught system. The feed pumps are by J. P. Hall & Co.; feed water heater and detartariser by Wm. Boby; the piping has been supplied by Stuart Lloyd; the valves by Dewrance & Co.; switchboard of the Edmundson pattern; the D.P. Battery Co. has supplied the storage battery which consists of 130 cells of 600 amperes-hours capacity, and each is connected with a large multiple regulating switch, which is controlled from the switchboard. A third Hornsby boiler is in course of erection, and is to be of the vertical type. The boosters were supplied by T. Parker, Ltd. The overhead travelling crane in the engine room is capable of lifting 5 tons.

Grimsby.—The T.C. has decided that consumers of energy for power purposes shall be supplied at 1d. per unit during the day time under certain conditions, and that charges for the time switch shall be as follows:—Motors up to 5-H.P., £2 a year; above 5 and up to 10-H.P., £2 10s.; about 10 and up to 20-H P., £3; above 20-H.P., £4.

nley.—On October 20th a L.G.B. inquiry was held
rel e to the application of the T.C. for a loan of £17,600 for
el c lightingtextensions.

Harrogate.—The T.C. has resolved to accept the offer of the B.T.H. Co. for the supply and erection of a 750-KW. Curtis turbine with condensers and accessories, for £6,736, and for the temporary loan of a 300-KW. turbine, free of cost, until the 750-KW. Curtis turbine can be supplied and erected.

Heavitree.—The U.D.C. on October 22nd decided to ask Messrs. Frank Suter & Co. if they are disposed to undertake the lighting of the district by electricity, and if so, upon what terms.

Huddersfield.—The T.C. has decided to apply to the B. of T. for a prov. order to enable it to extend the supply to Golcar.

Hull.—Mr. J. T. Skinner has retired from the chairmanship of the E.L. Committee through ill-health.

India.—An electric light and power plant is to be installed at the Insein workshops by Messrs. Burn & Co. at a cost of Rs. 33,500.

The Rangoon Municipal Committee, at the special meeting held to consider the report of Mr. Meares, electrical engineer to the Government of Bengal, on tenders for the electric lighting and power undertaking in Rangoon, resolved to call for amended tenders in the terms of Mr. Meares' note. The original tenders not having been accepted, five firms tendered, one of which was not considered as being in form. Mr. Meares adheres to his recommendation of last year for a continuous current system for Rangoon, and strongly objects to overhead wires.

Italy.—Application has been made for a concession to put down a plant to utilise the water power of the River Cartiere, near Grevone, in the generation of electrical energy for lighting and power purposes at Amalfi.

Kirkcaldy.—The Joint Sub-Committee of the T.C. and Harbour Commission intends, if possible, to promote the Bills for electric lighting and tramways and the harbour extension as one Bill.

Kettering.—The U.D.C. has decided to promote a special Act of Parliament conferring upon the Council powers to undertake wiring and the supply of electric light fittings and motors.

Karachi.—Messrs. Marshall, Sons & Co. have prepared a scheme for the lighting of the town, but owing to the funds of the municipality being insufficient, the scheme cannot be adopted. An essential feature of the scheme was the public lighting, without which it would not have paid sufficient returns on the outlay.

Kingswear.—The electric light was first switched on to the village for public lighting on the 22nd inst.

London.—WESTMINSTER.—It has been agreed that the City Council enter into a yearly agreement with the Westminster Electric Supply Corporation, Ltd., for the supply of electricity to the Council for lighting purposes at 3½d. per unit, and for power purposes at half that price without any guarantee as to minimum consumption, and that in the event of a general reduction being made to consumers, a proportionate reduction would be allowed to the Council.

STEPNEY.—The Electricity Committee of the B.C. has decided in favour of expending £2,845 in mains extensions, £1,670 in arc lighting extensions, and £250 in incandescent lighting extensions with Nernst lamps.

PADDINGTON.—The negotiations between the B.C. and the Metropolitan Electric Supply Co. for the lighting of the streets have fallen through.

CAMBERWELL.—The County of London and Brush Provincial Electric Lighting Co., Ltd., are to bring before the B. of T. the following conditions which the B.C. seek to impose with regard to placing a transformer box in Burbage Road:—"Application of company granted, subject to any disturbance of the footway or roadway being made good to the satisfaction of the borough engineer, and subject to an undertaking by the company that should the site or any portion thereof or the works connected therewith be required for public purposes, the company will pay the cost of removal or of any alterations."

Ludlow.—A L.G.B. inquiry was held on 22nd inst. into the application of the T.C. for sanction to borrow £8,250 for electric lighting purposes.

Mansfield.—Owing to the increase in the supply of electricity, the T C. has decided to extend the mains at a cost of about £1,000.

The electrical engineer has been instructed to select a slot meter for adoption, and to report on a scheme for supplying energy for power purposes.

Milford-on-Sea.—The electric light has just been inaugurated in the district. The work in connection with the scheme has been carried out by Messrs. Christy Bros. & Middleton, for the Milford-on-Sea Electricity Supply Co.

Pitlochry, N.B.—A scheme has been drawn up for the lighting of the town by electricity, and it is proposed to obtain the necessary power from the River Tummel.

Risca.—The Empire Electric Lighting Co. has notified the D.C. of its intention to apply for a prov. order to supply energy in the district.

Spain.—Work has just been commenced on the establishment of a central electric lighting station at La Guardia (Alavay).

Strabane.—Mr. Llewellyn Preece and Mr. R. V. Macrory visited the town last week for the purpose of locating a site for the Ulster Electric Power Co.'s proposed electric lighting and power scheme. The company propose to establish electric power stations in the towns of Newry, Portadown, Dungannon, Kilrea, Strablane, and Belfast, and for this purpose a special Act of Parliament is about to be promoted.

Tamworth.—The T.C. proposes to apply to the B. of T. for a prov. order to supply electricity to the town and the contiguous portions of the rural district. The Sir Hiram Maxim Electrical and Engineering Co. is applying for a similar order.

Thornbury.—The R.D.C. has applied for a prov. order for electric lighting in opposition to a syndicate which is making a similar application.

Wimbledon.—A L.G.B. inquiry has been held into the application of the U.D.C. for a loan of £1,300 for the provision of water storage plant at the electricity works.

ELECTRIC TRACTION NOTES.

Altrincham.—The poll on the electric tramways question has resulted in a majority of 213 in favour of the U.D.C. applying for a prov. order.

Batley.—The Healey and Mount Pleasant sections of electric tramways which have been constructed by the Batley Corporation and leased to the B.E.T. Co., were opened for the public convenience on Monday. Originally the Corporation intended to itself work the lines, but after negotiations it was decided to lease them to the company. Both sections start near the centre of the town and connect with the Traction Co.'s Dewsbury and Spen Valley main line. At present a quarter of an hour's service is being run, and this will be continued if the number of passengers warrants it. Energy is supplied by the Corporation. The cars are of the Westinghouse type. Steam trams are still running along Bradford Road from Dewsbury,

through Batley to Gomersal. This system is to be electrically equipped by the Traction Co., who bought out the shareholders some time ago, and it is expected that the work will be commenced early in the Spring.

Belfast and Bangor.—A scheme is on foot for the connection of the North of Ireland capital with Bangor, a fashionable watering place on Belfast Lough, by an electric tramway. The distance is 12 miles by road. Both places are already connected by railway.

Berlin Railways.—Reuter says that on 23rd inst. the Siemens electric car which is being used in the high-speed experiments, attained a speed of 128 miles per hour over parts of the course traversed. Reports of 131 miles having been attained have since been received.

The Berlin correspondent of the *Morning Post* says that the Prussian Government has decided to turn to practical account the magnificent results of the high-speed trials on the Berlin-Zossen Electric Railway. The Government has opened negotiations with a German electrical company for the construction of a high-speed electric railway between Berlin and Hamburg.

Brighton.—On Tuesday, the 20th inst., the Tramways Committee, accompanied by various officials, went round the recently completed extensions in London Road and the Old Steine for the first time, and as everything went off in a satisfactory manner, a request was at once sent for a Board of Trade inspector to come down. It is hoped to have the new routes open for the public early next week.

Cavehill and Whitewell (Ulster).—At a meeting of the Judicial Committee of the Privy Council at Dublin Castle last week, Mr. Ronan, K.C., applied on behalf of the Cavehill and Whitewell Tramways Co. for an order authorising them to increase their capital and extend their borrowing powers. In December, 1899, an agreement was entered into between the British Electric Traction Co. and this company which provided, amongst other things, that "the Electric Traction Co. should, as and when required by the company, subscribe, or find subscribers, for so many of the ordinary shares of the company of £1 each as should be necessary to provide the capital that may be required for the reconstruction, electrical conversion, and equipment of the tramway." The object of the present application for permission to increase the company's capital was, therefore, to enable the agreement to be carried into effect. The Committee held that, according to the provisions of the company's Act of Parliament, they had no jurisdiction to deal with the application. They expressed no opinion with regard to the merits of the case.

France.—*L'Industrie Electrique* published recently its annual statistics of electric railways and tramways in France. The applications of electric traction have not made such progress there as was at first expected, and this is due in a great measure to the poor financial results of many of the existing undertakings. The length of the lines reaches 1,994 kilometres, an increase of only 500 kilometres in two years, or an average of 250 kilometres a year. This increase is small, however, compared with that for the period 1900-1901, when it was near 700 kilometres. The power of the central stations has increased even less rapidly, it being 74,000 kilometres in 1903, or an increase of 10,000 over 1901, whilst it went from 28,000 to 64,000 in the year 1900-1901. The following are the chief characteristics of electric railways and tramways in France for the last 10 years:—

	1893.	1899.	1900.	1901.	1903.
Total length of lines in kilometres ..	37·4	487·5	752·8	1,486·3	1,994·7
Total power in kilowatts	1,525	18,718	28,808	64,883	73,997
Total number of carriages, automotors..	20	759	1,295	2,425	3,004
Number of lines with aerial conductor ..	2	42	56	76	85
Number of lines with underground conductor	0	2	3	3	3
Number of lines with projecting rail ..	1	1	1	4	5
Number of lines with accumulators ..	2	6	6	8	8
Number of mixed lines (accumulators and trolleys)	0	4	4	6	13
Number of mixed lines (trolley and underground cable)	0	1	2	2	4
Number of mixed lines (surface contact and trolley)	0	0	0	7	31

As can be seen, the number of trolley lines has scarcely increased for these last few years; on the other hand, the mixed surface-contact and trolley reach 31 in 1903 against 7 in 1901.

Glasgow.—In connection with the extension of the tramways to Paisley, the T.C. are experimenting with an improved process of electrically welding the rail-joints. The apparatus is being operated by the Lorain Steel Co. The extension to Paisley is expected to be ready for opening shortly.

Handsworth.—The South Staffordshire Tramways Co. have agreed to accept £5,250 for the part of the company's undertaking, including the Holyhead Road depôt, which is within the district; and the Corporation electrical engineer has been instructed to prepare plans, sections, and specifications for the reconstruction and re-equipment of the line.

Hull.—A service of electric cars between Hull, Whitefriar Gate Bridge and Victoria Pier was opened on 20th inst.

Liverpool.—Councillor Thomas Utley is again drawing attention to what he affirms to be the grave mistakes of the Tramway Committee in administering the electric tramways. For five months Mr. Utley has had a notice of motion on the Council summons asking that independent experts shall be engaged to report as to the cost of working the system; but a majority of the City Councillors are opposed to him, and when he rises to speak on an important subject of which notice has been given, it is found that there is not a quorum, and the house is "counted out," and Mr. Utley is foiled. He contends openly that the covers for the electric cars, which were ordered at a cost not exceeding £60 each, could have been obtained under tender for £30 each, and that the types of covers obtained so far have been unsuitable, costly, and wrong in principle.

Llanberis.—Our Pontypridd correspondent says:—"In the quarry districts operations are proceeding with the view of starting the great electrical works at Llyn Llydaw. Engineers are surveying land for the purpose of laying down a railway from Portmadoc through Gwynant Pass on through Bettwsycoed to Corwen, which will be worked with electric power if the scheme is carried through."

London.—Sir Herbert Jekyll presided on Tuesday over a conference of West Middlesex local authorities as to the formation of by-laws governing the service of the London United Electric Tramways. Mr. Balfour Browne, K.C., and Mr. Clifton Robinson were for the company, and Twickenham, Chiswick, Brentford, Hanwell, Teddington, Hampton, and Hampton Wick districts were represented. Dealing with the arguments adduced, the president said that in many instances the drafts submitted by the different authorities exceeded the model code of the Board of Trade, and there must be uniformity. This particularly applied to the speed of the electric cars. Some districts wanted them to run above the Board of Trade standard, others below, but anything done would have to be subject to the Board of Trade. The Board quite recognised that the code as it applied to old horse traction was quite inoperative in the altered condition of electric traction, and they were considering the question of speeds. He advised that the existing conditions should be left unchanged, and the Board would communicate with the district authorities when the new speed limits were fixed. The Brentford Council asked for a speed indicator on each car, but that was quite unpractical, and would have to be dropped. The suggestion of Brentford that every car should be disinfected once a month to the satisfaction of the local authority was *ultra vires*, and the idea of the same body that each conductor should produce the by-laws when called upon was governed by the Board of Trade regulations. Mr. Clifton Robinson said the company would give a bonus of £500 to any one who could design a reliable speed indicator. Mr. Balfour Browne questioned the power of the local authorities to make by-laws, but the president at that stage would not entertain a legal argument.—*The Times.*

London County Council.—At a meeting of the Council on Tuesday, the Highways Committee reported that it would be necessary to remove certain pipes and mains under the carriageway of Tower Bridge Road in connection with the construction of the tramway in that road. Some of the mains belong to the Bermondsey Borough Council, which had received notice from the Council's contractors to remove the mains in order to provide sufficient depth for the formation of the conduit. The Borough Council suggested that the mains should be placed as far as possible in the Tower Bridge Road subway and its laterals, but the best and least expensive course to adopt would be to carry the mains through the arch of the subway. It was decided to permit the Borough Council to effect the removal in the latter manner.

An expenditure of £2,500 was approved for making surveys, preparing plans, &c., in connection with the proposed reconstruction of the Streatham cable tramways, the extension of the lines from the present terminus in Tooting High Street for a short distance along Defoe Road, so as to provide a fresh terminus, and the acquisition of certain tramways south of the Thames.

Manchester.—It is stated that a gross profit of £91,771 is shown as the result of the last half-year's working of the Corporation Tramways. The revenue amounted to £315,970, and the working expenses, including depreciation, £228,496. The *Daily Dispatch* says that it is intended to dispose of this profit as follows:—Interest, £24,302; sinking fund, £12,605; rent of lines, £10,858; and leaseholds, £900, the net profit being £43,405. Mr. M'Elroy, the general manager, points out that the half-year just closed, embracing as it did the whole of the summer traffic, would, of course, show a much better financial result than the coming half-year, and consequently it would be fallacious to estimate the financial results for the year on the basis of the first half-year's profit. The depreciation allowed for was arrived at as follows:—Permanent way at £400 per mile of single track per annum, the estimated average life of the track being 10 years. Rolling stock 5 per cent. on the outlay. The cars will be efficiently maintained out of revenue. Overhead equipment 5 per cent. on the outlay. The principal item of cost of the overhead equipment is that of the poles. These will not to any marked degree depreciate, and the trolley line itself will be efficiently maintained out of revenue. The sum put down for depreciation in this case, therefore, may be viewed in the light of a charge for obsolescence of plant. In a summary comparing the operating expenses per car-mile during the half-year against the previous 12 months, it is shown that with the exception of traffic salaries and wages, rents, rates, car repairs, and permanent way repairs, all the items showed an increase. The increase under the head of wages was due to the advance given to the men at the commencement of the year, and the increase under the head of rents, rates, &c., was due to the increased assessment of the track and equipment for rating purposes.

West Ham.—Members of the Institute of Marine Engineers last Saturday week inspected the West Ham electric power station at Canning Town. This large station is not yet complete, but it is anticipated that within six months the whole of the machinery will be in working order. The visitors were received by Alderman Kettle, the mayor, and Mr. Councillor Byford, the deputy-mayor, and by Mr. J. K. Bock, the borough electrical engineer. The installation at the beginning will comprise two 2,000-H.P., two 1,000-H.P., and two 500-H.P. engines and alternators for lighting; and three 750-H.P. engines and dynamos for tramways. There are 17 Babcock & Wilcox water-tube boilers. The visitors were subsequently conveyed to the old station at Abbey Mills, and here, of course, everthing was in full working order, although the engines were not all running at the moment. The new Canning Town station, together with the generating plant, will cost approximately £164,000, and the capacity of the plant at present on order will be 9,100 H.P.

TELEGRAPH AND TELEPHONE NOTES.

Hull Telephones.—The Corporation on Wednesday last week received sanction for a loan of £43,000 for starting the municipal scheme. A full report of the inquiry appeared in our columns some weeks ago.

Indian Telegraphs.—Proposals are definitely under consideration for the reduction of the rates of inland telegrams.

New Zealand Cables.—The *Sydney Daily Telegraph* for September 14th contained the following interesting dispatch:—

With regard to the threat of the Eastern Extension Co. to lift their two cables between New Zealand and Australia unless better support is accorded by the mercantile community, Sir Joseph Ward, Postmaster-General, in the course of an interview, said:—

"The intimation that there is a possibility of the Eastern Cable Co. lifting the cables between Australia and New Zealand is a question that ought not to in any way disturb this colony. If the Eastern Co. were to carry out its threat, I should hail it with much satisfaction, as it would give an opportunity of putting down a State-owned cable direct between the Commonwealth and this colony; and this, with the present portion of the Pacific cable now connecting us with Queensland, would give the colony a splendid service between the two countries.

"If the Eastern Co. are anxious to get out of the inter-colonial trade, the Government of New Zealand are quite prepared to negotiate their cables, provided the price is satisfactory.

"It probably has escaped public attention that some time ago I asked a representative of the company whether they were prepared to sell their cables, and, if so, to state the price. Beyond a reply that the matter would be referred to the directors, I have received no further intimation of any kind from him on this head.

"In my opinion, the ideal cable system between Australia and New Zealand would be a State-owned one, with greatly reduced inter-colonial rates compared with those already existing. The old idea of high cable rates per word ought to be consigned to oblivion.

"My own opinion is, that the rates between Australia and New Zealand will never be satisfactory until brought down to the level of rates for land lines, so as to bring their use within the reach of all. There is no doubt when that time arrives the revenue will be an eye-opener compared with anything that has hitherto been achieved over submarine cables with the restrictive rates that have been in existence."

Simla Telegraphs.—On 21st inst. a farewell dinner was to be held at the United Service Club, at Simla, to officers of the Government of India about to retire from service. Mr. Maclean, Director-General of Telegraphs, is among those retiring.

Swansea Telephones.—The municipal telephone system has at present 378 lines working, and the rentals will open on November 5th, the date of the official opening of the exchange.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara No. 1	Aug. 27, 1901	..
Dominica-Martinique	May 7, 1902	..
St. Lucia-Martinique	May 7, 1902	..
Guadeloupe-Martinique	May 7, 1902	..
Cayenne-Pinheiro	Aug. 13, 1902	..
St. Lucia-St. Vincent	Sept. 19, 1902	..
Reissa-Issa (Yemen)-Camaran	Oct. 22, 1902	..
Paramaribo-Cayenne	Feb. 27, 1903	..
New York-Haiti	April 13, 1903	..
Nagasaki-Fusan	Oct. 19, 1903	Oct. 26
Japan-Corea	Oct. 19, 1903	Oct. 27
Landlines		
Communication with Puerto-Barrios	July 28, 1903	..

Wireless Telegraphy.—Further experiments with Marconi's system are to be instituted by the Telegraph Department in India during the ensuing cold weather.

Dr. de Forest, the inventor of a system of wireless telegraphy much used in America, has been over to show its value to the British Post Office authorities.

CONTRACTS OPEN AND CLOSED.

OPEN.

Barrow-in-Furness.—The Corporation wants tenders for the completion of the electric lighting installation at Hawcoat and Walney Police Stations and the Pig Slaughtering Hall and Lairage at the Public Abattoirs. Particulars at the borough engineer's office, Town Hall.

Beckenham.—November 9th. Electric wiring under free wiring scheme. See "Official Notices" October 16th.

Bermondsey.—November 9th. Low-tension feeder, and arc lighting, cables; arc and incandescent lamps, standards, switch-boxes, &c. See "Official Notices" to-day.

Blackpool.—November 14th. One 450-KW. traction set (vertical triple-expansion engine and multipolar generator). See "Official Notices" October 23rd.

Chorley.—The Corporation invites offers for its electric lighting order. See "Official Notices" October 23rd.

Glasgow, &c.—May-Oatway Fire Appliances, Ltd., are inviting tenders for wiring for a number of installations of their fire alarm system. See "Official Notices" to-day.

Harrogate.—November 16th. High tension mains. See "Official Notices" to-day.

Johannesburg.—November 16th. Gas producer plant; gas engines and dynamos. Alternative:—Water-tube boilers, steam engines or turbines, electric generators, and other plant. For the municipal tramways and electrical supply scheme. See "Official Notices" August 28th.

Kilmarnock.—November 18th. Lancashire boilers; engines and dynamos; crane; battery; and switchboard for electricity scheme. See "Official Notices" October 9th.

Leeds.—November 13th. Forty-five tons of piping and valves for the electricity works. See "Official Notices" October 23rd.

London.—November 3rd. Engine, dynamo, wiring, &c., for an installation at the Abbey Mills Pumping Station at West Ham, for the L.C.C. See "Official Notices" October 2nd.

Manchester.—November 5th. The Paving, Sewering and Highways Committee invite tenders for laying underground telephone pipes (Contract No. 8), with other appurtenant works. Specification, &c., at the City Surveyor's Office, Town Hall, Manchester (two guineas.)

Radcliffe.—November 14th. Lighting and traction switchboards and accessories; rail bonds for the U.D.C. See "Official Notices" October 23rd.

Spain.—November 5th. Tenders are being invited until November 5th by the Municipal Authorities of Caraminal (Coruna province) for the concession for the electric lighting of the town during a period of 20 years. Tenders are to be sent to El Secretario del Ayuntamiento de Caraminal (Coruna) whence particulars may be obtained.

Swansea.—October 31st. Permanent way, rails, special work, overhead equipment, cables, ducts, &c., for tramways. See "Official Notices" September 25th.

Swansea.—October 31st. Ducts, troughs, cables, wires, street boxes, &c. See "Official Notices" September 25th.

Swindon.—November 16th. Steel poles, overhead equipment for tramways, arc lamps, &c., for the Corporation. See "Official Notices" to-day.

Sydney (N.S.W.).—December 30th. Tenders will be received at the office of the Deputy Postmaster-General, Sydney, New South Wales, from persons desirous of contracting for the supply to the Departmental Stores, Sydney, of telegraph, telephone, and electric light material. Specifications, &c., may be seen, and tender forms obtained at the General Post Offices, Sydney, Melbourne, Brisbane, Adelaide, Hobart and Perth. Samples may also be seen at Sydney, Melbourne, Brisbane and Adelaide.

Todmorden.—October 31st. Lancashire boiler; steam dynamos, pumps, switchboard, battery, cables, crane, &c., for electricity supply. See "Official Notices" October 9th.

Wednesbury.—November 20th. Electric wiring of public buildings. See "Official Notices" October 23rd.

CLOSED.

Aberdeen.—The T.C. has accepted the tender of Mr. P. Tawse for the construction of a new cable subway for £9,799. The subway is to be 6 ft. 6 in. high × 4 ft. 6 in. wide, and in length about 700 yds. An electric fan is to be erected for ventilating, and electric lights will be placed throughout the tunnel. The subway is to hold 52 cables, and if necessity arises 12 more.

Bradford.—The T.C. has accepted the tenders of Mr. John Best, for the construction of a tramway from Pateley Bridge to Lofthouse, at £20,300, and also for a tramway from Lofthouse to Angram Reservoir, at £5,385.

Bradford.—The contract for the electric lighting of Lapage Street Board Schools and Swimming Baths has been secured by the Bradford Electrical Engineering Co.

Brighton.—The Tramways Committee received tenders from six firms in response to its advertisement for tenders for 20 fully-equipped electric cars:—

Brush Electrical Engineering Co.	£10,310
Dick, Kerr & Co.	10,200
,, ,, (alternative)	10,550
Witting, Eborall & Co.	10,650
British Electric Car Co., Ltd.	10,790
British Thomson-Houston Co.	10,940
British Westinghouse Co.	11,340

For 800 Tons of Rails, Fishplates, &c.

P. & W. McLellan	£5,157
Brush Electrical Engineering Co.	5,227
A. Penney & Co.	5,227
H. Gielgud	5,408
P. P. Wimby & Co.	5,687
Bolckow, Vaughan & Co.	5,962
Walter Scott & Co.	6,221
Macleod & Co.	7,132
E. Le Bas & Co. (incomplete)	4,685
Steel, Tozer & Peech (incomplete)	5,996

For Points and Crossings, Bolts, &c.

Edgar Allen & Co.	£2,905
Hadfield's Steel Foundry Co.	2,919
Brush Electrical Engineering Co.	3,216
P. and W. McLellan	3,352

The Tramways Committee, after duly considering the tenders, recommend the Town Council to accept the following:—

Cars, Dick, Kerr & Co.	£10,200
Rails, Bolckow, Vaughan & Co.	5,962
Points and Crossings, Hadfield's Steel Foundry Co.	2,023
Sole plates, Edgar Allen & Co., Ltd.	687

Bristol.—The Electrical Committee of the T.C. on Friday accepted the tender of Mr. McNaughton for arc lamp carbons.

Bolton.—The T.C. has accepted the tender of Messrs. Green & Sons for the supply of economisers for the electricity works.

Devonport.—The following is a list of tenders submitted to the Corporation Electricity Department for negative booster:—

	Guaranteed efficiency.	Contract Price.
Walker & Hodgetts, Ltd.	80%	£310
British Electric Plant Co., Ltd.	70%	310
Crompton & Co., Ltd.	73%	313
Brush Electrical Engineering Co. (accepted)	84%	327
Siemens Bros. & Co., Ltd.	72·25%	332
Industrial Engineering Co., Ltd.	72%	338
Bruce Peebles & Co., Ltd.	79%	341
Keighley Engineering Co., Ltd.	80·5%	347
Johnson & Phillips	81%	375
Rhodes Electrical Co.	77%	390
Mavor & Coulson, Ltd.	79%	393
Thomas Parker, Ltd.	77·5%	393
British Westinghouse Co., Ltd.	79%	397
Lancashire Dynamo and Motor Co., Ltd.	78%	410
Laurence, Scott & Co.	75%	420
Mather & Platt, Ltd.	75%	425
Lister Electric Manufacturing Co., Ltd.	76%	433
British Schuckert Electric Co., Ltd.	76%	455
Electric Construction Co., Ltd.	80%	465

The Brush Co.'s tender was accepted on account of the high efficiency guaranteed.

Hackney and Stepney.—Messrs. Rowland Carr & Co. have secured the order as sub-contractors to Messrs. Crompton and Co., Ltd., for 40 arc lamp columns and accessories for Hackney. They have also obtained a further order from the New Century Arc Lamp Co., for 40 arc lamp columns required for Stepney. In addition, Messrs. Carr have booked the contract for the steel troughing required in connection with the electrification of the Underground Railways.

King's Norton and Northfield.—The U.D.C. has accepted the tender of Messrs. R. W. Blackwell & Co. for the overhead equipment of the Pershore Road tramway at £2,718.

Sheffield.—The T.C. has accepted the tender of the National Rail and Tramway Appliances Co. for the supply of 75 car sets of National life-guards at £5 5s. each.

Southend.—The T.C. has accepted the tender of Messrs. Crompton & Co., for the supply of instruments for the electricity works at £163.

FORTHCOMING EVENTS.

Saturday, October 31st.—At 7.30. Glasgow Technical College Scientific Society. Paper by Prof. Alexander MacLay on "The Evolution of a Technical College."

Tuesday, November 3rd.—At 8 p.m. London Electrical Contractors' Association. Frascati Restaurant, Oxford Street, W. Paper on "A model Specification for Contractors' Use," by Mr. W. R. Rawlings.

[Other fixtures are:—December 1st, Mr. F. B. Joseph on "Are we Tradesmen?" January 5th, Mr. R. B. Johnson on "The Necessity for the Standardisation of Wiring Rules."]

At 8 p.m. Institution of Civil Engineers. First ordinary meeting. Address by Sir William H. White, the President, and presentation of medals and prizes awarded by the Council.

Wednesday, November 4th.—At 6.30 p.m. Institution of Electrical Engineers (Glasgow). Second Annual Dinner, at the Grand Hotel.

Thursday, November 5th.—At 8.30 p.m. Röntgen Society. Meeting at Hanover Square. Presidential address.

Saturday, November 7th.—At 7 p.m. Salford Science Students' Association. Meeting. Questions for discussion:—

1. What is the best form of condenser for highly superheated steam?
2. The keying of bosses to shafts.
3. What are the possibilities of Aerial Transportation between England and France?
4. Is it advisable to use high pressure steam, and what are the drawbacks experienced in present day practice?

Tuesday, November 10th.—At 8 p.m. Institution of Civil Engineers. Paper on "Tensile Tests of Mild Steel, and the Relation of Elongation to the Size of the Test-Bar," by Prof. W. C. Unwin.

Thursday, November 12th.—At 8 p.m. Institution of Electrical Engineers. Meeting. Inaugural address by Mr. Robt. K. Gray.

NOTES.

Kilroy Stoking Indicator.—We regret that, in our description of this apparatus in our last issue, we omitted to mention the fact that the apparatus is, of course, patented.

Electro-Deposition upon Aluminium.—Writing in the *Chemiker-Zeitung* lately, Dr. A. Fischer remarks that in many cases it is a difficult matter to obtain a sound and adherent film of some foreign metal by electro-deposition upon ordinary aluminium. Various methods of procedure and numerous baths have been patented, but these are usually of little value. The porosity and irregular degree of purity possessed by commercial aluminium have also been offered as excuses for the troubles of the plater. The author has, however, had considerable and prolonged experience of the whole subject, and offers the following suggestions as trustworthy:—Coatings of copper, silver, nickel, zinc, and tin may be obtained directly upon aluminium; but films of gold, "brass," and arsenic are best applied upon substrata of copper, nickel, or silver. Aluminium coated with copper or silver can be "oxidised," and there will be no danger of the deposit coming off; but the use of hot liquids, and more particularly of hot solutions of alkali sulphites, must be avoided, or the deposit may blister. If the aluminium has been tarnished by exposure to air it should be cleaned by the process recommended by the Neuhausen factory. The articles are immersed for 15 seconds in a 10 per cent. solution of caustic soda which has been saturated with common salt, taken out, washed, rubbed with powdered pumice, dipped for another 20 seconds, treated with a German-silver scratch-bush, and dried. Aluminium containing copper should be dipped in nitric acid, or cleaned by heating. Before immersion in the electro-depositing bath the goods should be well cleaned with a bristle-brush and pumice. For coppering, the old bath containing 100 grams of copper sulphate and 60 grams. of nitric acid (sp. gr., about 1·3) dissolved in 1 litre of water works perfectly. A cyanide copper bath cannot be used, because it seriously attacks aluminium. The current density should be $ND_{100} = 1$ to 1·7 amperes, and the voltage 0·5 to 1·0. For silvering, Prof. Neesen's process is good. The aluminium articles are momentarily dipped in hot nitric acid, washed in water, soaked for a few minutes in 10 or 15 per cent. caustic soda or potash, then put without washing into a solution containing 5 grams of mercuric chloride per litre, rinsed, dipped again in the alkali, and finally without rinsing put directly into the cyanide silver bath. A somewhat high pressure (about 2 volts) should be employed at first. The deposit of silver adheres well, may be scratch-bushed, and bears burnishing with steel and bloodstone. The nickel bath should contain nickel sulphate, 50 grams.; ammonium chloride, 30 grams; water, 1 litre. Current $ND_{100} = 0·1$ to 0·15 ampere. In two or three hours the deposit is thick enough to bear polishing with oil and whiting. For tin the bath should be sodium pyrophosphate, 20 grams; fused stannous chloride, 8 grams; water, 1 litre. The voltage should be between 2 and 3. The film can be polished by scratch-brushing. For zinc the bath may be zinc sulphate, 180 grams; dry sodium sulphate, 50 grams; water, 1 litre. Voltage = 4. Many varieties of "magnalium" can also be coated by the methods described above.

North Metropolitan Power Co.—That section of London's travelling public which is anxiously looking forward towards the long promised electrification of the tramways in the northern suburbs of the metropolis, will be gratified to learn that the North Metropolitan Power Co. who will supply the energy for working these lines, in addition to their power distribution area in Hertfordshire and Middlesex, have made a good start on the main generating station buildings which are situated at Brimsdown, on the banks of the River Lea. The plant which will be installed is of modern design, and consists, in the first instance, of three 1,000-KW. Brush-Parsons turbo-generators with space for a fourth similar set. Steam will be supplied from six of the largest type Babcock & Wilcox boilers, each having 4,400 sq. ft. heating surface, and being fitted with superheaters and chain grate stokers. There is space provided for two more boilers in the range, and the boiler capacity can ultimately be duplicated by the addition of another eight boilers, facing the first installation. Coal storage is provided for in steel bunkers of 1,000 tons capacity. These are arranged at some considerable height above the firing floor, the coal falling by gravity into the hoppers of the stokers. The ashes also fall by gravity on to the conveyor, which is to be of the Hunt type, and runs under the firing floor, up and down the end of the building and over the bunkers in the usual way. A special dock is provided on the River Lea, and an electrical travelling crane will be used for unloading coal from barges, and filling through a weighing hopper, the conveyor. A special ash hopper will be provided which can be emptied into barges if desired.

In addition to the turbo-generators in the engine room, two 100-KW. and two 50-KW. Belliss exciting sets are to be provided. Each turbine will exhaust direct into a surface condenser in the basement, supplied by Messrs. Mirrlees, Watson & Co. These will each have 2,500 sq. ft. cooling surface, and will be provided with motor-driven three-throw Edwards air pumps 12½ in. diameter × 6 in. stroke, also motor-driven 10 in. centrifugal circulating pumps. There is also a smaller auxiliary condensing plant for the exciters, which is provided with single air and centrifugal circulating pumps, driven by a motor placed between. A 24-in. atmospheric exhaust pipe with an outlet at the end of the building, runs along the basement, and is connected to the turbine exhausts through automatic relief valves. The circulating water for the condensers is drawn through a suction pit from the river. High and low tension switchboards are provided at one side of the engine room, a transformer chamber being arranged behind. A 25-ton electrical travelling crane, by Carrick & Ritchie, spans the engine room.

The buildings also comprise workshop, stores, battery room and offices. The engine room measures 145 ft. long by 48 ft. wide, and the boiler house will eventually be 90 ft. wide. The buildings are steel frame structures of handsome design, a steel chimney 150 ft. high and 10 ft. internal diameter is provided. The whole of the steel work, including the chimney, amounting to upwards of a thousand tons, as well as all the architectural work, has been designed, for the Brush Electrical Engineering Co., who have the contract for the generating station and plant, by Mr. W. C. C. Gray, of Adelphi Street, Strand, W.C., he having carried out several similar buildings for the Electric Power Distribution Co., Ltd.

Boiler Design and Construction.—"Notes on Material, Construction and Design of Land Boilers," is the title of a pamphlet issued by the National Boiler Insurance Co. It forms a brief and useful survey of the whole art of modern boiler making in considerable detail, including plate strength, test strips, defects of plates, riveting, fitting blocks, end stays and other points of importance. Some excellent information is provided on gusset stays and points to be avoided, but the few remarks on cross tubes are weak, and only carry the question as far as that of ease of inspection. This simply begs the question. The cross tube is essentially bad, and even as a strengthener probably is no better than a thick link in a thin chain. We read that 8 ft. 6 in. is the biggest diameter of boiler that can be carried by rail as a rule. The Galloway boiler is pictured without description. This also appears a weak course to adopt, for the flue shape must present to the young engineer a puzzle of a somewhat curious order. We should also like to have seen a positive statement that every tube of a water-tube boiler should be solid drawn, and not have had this virtue permittedly confined to the rows nearest the fire. These few defects, however, do not detract seriously from an otherwise excellent little treatise.

Electrical Enterprise in Italy: Reported Action of English Companies.—The Milan correspondent of the *Frankfurter Zeitung* learns that Herr Savrasin, banker, the Alioth Electricity Co., of Basle, the Exploration Co., and the General Water Power Co., of London, are interesting themselves in a scheme proposed by the Lombardy Co. for the distribution of energy for the establishment of new hydro-electric works on the Poschiavosee, at Graubunden. It is estimated that the water power available is equivalent to 20,000 H.P., and the negotiations in regard to the matter have so far proceeded that an early conclusion is anticipated. The Lombardy Co. is a promotion of the German Schuckert group, who have, however, entirely withdrawn from the undertaking. In future Switzerland and England will take the place of Germany in the company, this being the first time for English companies to concern themselves with an electrical enterprise in Italy.

New York Electrical Society.—Prof. W. E. Ayrton, F.R.S., gave an informal talk on "Some Electrical Measuring Instruments, and the Recent Use of Them," at the opening meeting of the present session held in the American Institute on the 19th inst. Prof. Ayrton is visiting the United States in connection with the Mosley British Educational Commission.

The London Chamber of Commerce.—On Wednesday afternoon, together with a party of other Press representatives, we were afforded an opportunity of inspecting the new offices of the London Chamber of Commerce, in Oxford Court, Cannon Street, E.C. In its old premises in Eastcheap the Chamber was undoubtedly cramped; and in view of its increasing activity in many important directions—especially its valuable work in connection with commercial education—it was most desirable that a change to a building more worthy and capacious should be made. The amount of work devolving upon the London Chamber is infinitely greater than that of such Chambers in the provinces, and this may be easily understood from the mere fact that, whereas many provincial Chambers are limited to practically one particular industry, that in the metropolis has to cover every imaginable class of trade. This is so because London is a great importing and distributing centre. The London Chamber has met the situation by relegating different trades to forty trade sections, and in addition to these it works in conjunction with as many as fifty independent trade societies. Our readers already know something of the work which is undertaken from time to time by the Electrical and Allied Trades Section, but there are others, such as the Metal Trade Section, Chemical Trade Section, Engineering and Allied Trades Section, the Lamp Trade Section, and the Iron-founders' Trade Section, all of which have a certain connection with the interests concerned in electrical development. Then the Chamber has a number of special committees at work, upon such subjects as Municipal Trading, Postal Telegraphs and Telephones, Commercial Education, Commercial Law, Secret Commissions, and so on. Lord Brassey, the present president, dwelt at Wednesday's meeting, upon the work of the Chamber, and said that the Council would welcome additions to the membership; these additions were necessary to enable the Chamber to keep pace with the cost of its ever-growing labours. Particulars as to the privileges obtainable by members, such as facilities for securing information on statistical matters, tariffs, markets, trade customs and certificates of origin, will be readily accorded by Mr. Kenrick B. Murray, the secretary, at Oxford Court. The position of the new offices is an excellent one for city men. The membership at present is 3,800, but these are not confined to 1 square mile which forms the City proper, some of them being scattered throughout greater London, and even in the provinces.

The Junior Institution of Engineers.—The annual general meeting of this Institution was held at the Westminster Palace Hotel on October 24th, the principal business consisting of the Council's report and accounts, and the election of officers for the ensuing year. The report stated that the total membership was now 746. Ten meetings for the reading and discussion of papers had been held, the Institution Premium having been awarded to Mr. R. W. Newman, A.M.I.C.E., for his paper on "The Effect of Design on Methods of Construction, from a Contractor's Point of View." Twelve visits to engineering works, &c., had taken place, in addition to those of the summer meeting, occupying one week, Sheffield and the Peak District having been the *rendezvous*. The accounts showed that the sum of £300 had been invested, and that the income had been £156 more than the expenditure. The election of Mr. J. Fletcher Moulton as the new President, proposed lectures on the theta-phi diagram by Prof. John Perry, library, certificate of membership, and Fire Prevention Congress, were referred to in the report. The election resulted as follows:—Chairman, Mr. S. Cutler, jun.; Vice-Chairman, Mr. Adam Hunter. The programme of papers for the new session was announced:—November 20th, "Fires on Shipboard," by Mr. G. Canning; December 4th, "Gas Engines," by Prof. D. S. Capper; January 22nd, Mr. Moulton's Presidential Address; February 5th, "Producer Gas Power for Ice Factories," by Mr. Hal Williams; March 4th, "Electric Storage Batteries," by Mr. G. C. Allingham; April 8th, "Heating and Ventilation of Factories," by Mr. K. Gray; May 6th, "The Design of a Dry Dock," by Mr. A. W. Young. Those of our readers desiring particulars of membership of this useful society should communicate with the Secretary, Mr. W. T. Dunn, 39, Victoria Street, Westminster.

Electricity Direct from Coal.—At the inaugural meeting of the Bradford Engineering Society, Mr. G. F. Charnock, head of the Engineering Department of the College and President of the Society, delivered a lecture on "The Possibility of Producing Electricity Direct from Coal." After alluding to the very low efficiency of the best steam-driven plant which had yet been introduced, the lecturer proceeded to explain the various methods which had been proposed to generate electrical energy without the aid of the steam engine. By means of lantern slides and a collection of experimental apparatus, several forms of carbon-consuming batteries thermopiles, and "pyro-magnetic" motors were described and illustrated. None of these attempts had in any sense proved commercially successful, and, extremely wasteful as it undoubtedly was, the steam engine—or more correctly speaking, the heat engine—still out-distanced all its competitors. In conclusion, Mr. Charnock quoted the recent prophecy of Sir Frederick Bramwell concerning the "passing" of the steam engine, and alluding to a similar prediction made by Edison some years ago, said he was afraid we should have to go on pushing pistons and turning cranks for some time to come.

Pickering v. Urban Electric Supply Co.—Before Mr. Justice Farwell, in the Chancery Division, on Monday, October 26th, Mr. Maughan stated that an order had been agreed to between the parties in the action brought by Messrs. John Pickering & Sons against the Urban Electric Supply Co., Ltd. The order would stop further proceedings. The action was in regard to the laying of a cable which plaintiffs said was an infringement of their rights. His Lordship sanctioned the arrangement which had been come to.

Manchester and Mr. Metzger.—It had been expected that a discussion would arise at Wednesday's meeting of the City Council respecting Mr. Metzger's resignation, but practically nothing new was said. The chairman of the Electricity Committee, Mr. Howarth, made a brief statement, and subject to the deletion of the words "on the ground of his inability to work in unity with the deputy-chairman," the minutes relating to the resignation were approved. Mr. Metzger's resignation is therefore finally accepted.

U.S. and German Electrical Companies.—It is announced that the arrangements entered into by Herr Rathenau during his sojourn in the United States relate to a liberation of the Union Electricity Co. of Berlin from certain geographical restrictions hitherto imposed upon it by agreements with the United States Thomson-Houston Co. The negotiations on this question have been conducted by Herr Rathenau, who is a director of both the Union Co. and the Berlin General Electricity Co., with the American General Electric Co., which is the principal shareholder in the Thomson-Houston Co. It is expected that the details of the fresh arrangements will be published on the return of the German director to Berlin.

Fatality.—An accident attended by a fatal result occurred at the Bootle electricity works recently while plant extensions were being carried out. New boilers and superheaters were being installed at the time, and a superheater weighing 25 cwt. was being placed in position above one of the boilers by means of a derrick and pole when, owing to the breaking of a guy rope, the pole swung against the boiler and broke, causing the superheater to fall among the men who were below. One man named Riley was crushed against the boiler. He was taken to the Bootle Hospital, but on arrival was found to be dead. Three other workmen were injured, though not seriously.

Auction Sale.—For the sale which takes place at the Castle Works, Northfleet, on November 4th to 6th, Messrs. Wheatley Kirk, Price & Co. have issued a very complete catalogue of the various lots (some 800) of plant and machinery which are to be put up to auction. The sale is of sufficient magnitude to make it possible to illustrate a number of the chief lines. The blocks give excellent photographic views, which, with the accompanying descriptive matter, suffice to give the would-be purchaser a good idea of the machines to be offered, and may help him to decide whether it is, or is not, worth his while to personally inspect them.

Personal.—The control of the permanent way of the Reading Corporation Tramways has been transferred from the borough engineer to Mr. W. Binns, the engineer and manager of the tramways department.

The Committee of the National Physical Laboratory has appointed Mr. W. A. Caspari, B.Sc., Ph.D., to the post of junior assistant in the chemical department.

It is reported that Mr. A. L. C. Fell, of the Sheffield Tramways Department, is recommended for the appointment of manager to the L.C.C. tramways.

Mr. James Heald, Chairman of the Electricity Committee of the Lancaster Town Council, has been returned unopposed for Park Ward, which he has represented about 11 years. Mr. Heald is head of the firm of Calvert & Heald, electrical engineers and fitters, Lancaster.

The *Times* announces that Prof. H. S. Hele-Shaw, of Liverpool University, has been appointed, through the Colonial Office, to organise technical education in the Transvaal and the Orange River Colony. The appointment is not a permanent one, and Prof. Hele-Shaw has been granted leave of absence by the University Council until September next. In his mission, the Professor will take into view not only the immediate organisation of technical education, but the future University scheme of the Colonies named.

Mr. H. Smethurst has terminated his engagement with Messrs. Wheatley Kirk, Price & Co., London, after 18 years' service with the firm as chief-of-the-staff, and has commenced business on his own account as valuer, &c., to the engineering and allied trades, which will be conducted under the style of H. Smethurst & Co., at 37, Ommaney Road, New Cross, S.E.

Appointment Vacant.—Engineer-in-charge (£104) for Bermondsey. See our advertisement columns to-day.

THE CENTRAL STATION ENGINEER.

The Watford U.D.C. has increased the salary of the chief assistant engineer at the electricity works (Mr. Weston), from £100 to £120. There was some opposition in the Council meeting, not because of any unfitness on the part of the applicant, for the increase was recommended by the engineer, who pointed out that Mr. Weston's £100 was below the average attaching to such posts in other electricity supply works. We are glad that wisdom prevailed, for it is only by displaying a greater reasonableness in dealing with the assistants in electricity works that the present changing about from place to place is to be prevented.

Mr. F. B. O'Hanlon, of the Great Northern Railway Electric Lighting Station, has been appointed assistant electrical engineer at the Hampstead Municipal Electric Lighting Station, in place of Mr. J. F. Magoris, resigned.

Mr. A. Peden Rutherford, Corporation electrical engineer at Leith, has withdrawn his resignation, and accepted an advance of salary from £270 to £400, which was the salary offered him by the Aston Corporation.

Mr. Jos. Ainscough, A.M.I.E.E., has been appointed chief assistant electrical engineer to the Kendal Corporation.

Mr. G. H. Saunders, an engineer-in-charge at the Taunton Corporation Electricity Works, is leaving those works to take charge of the temporary plant in connection with the Loughborough electricity scheme.

NEW COMPANIES REGISTERED.

Gent & Co., Ltd. (78,797).—This company was registered on October 13th, with a capital of £50,000 in £1 shares (20,000 preference), to acquire and carry on the business of manufacturing electricians, electrical engineers, wire and cable manufacturers, wire coverers, &c., carried on by A. W. Staveley and I. H. Parsons at Leicester as "Gent & Co.," and the "Midland Electrical Wire Co.," and to carry on the said business and that of telephone, water supply and mechanical engineers, iron and brassfounders, manufacturers of speaking and pneumatic tubes, makers of workmen's and watchmen's check clocks, water-level indicators and recorders and other machinery and appliances, tool makers, metal workers, millwrights, machinists, boiler makers, iron and steel converters, smiths, wood workers, builders, hardwaremen, manufacturers of rolling stock, &c. The first subscribers (each with one share) are:—A. W. Staveley, "Walsoken," Stoneygate Road, Leicester, electrical engineer; I. H. Parsons, St. Elmo, Woodland Avenue, Leicester, electrical engineer; W. Levi, 154, Fosse Road South, Leicester, electrical works manager; Mrs. H. Staveley, "Walsoken," Stoneygate Road, Leicester; Mrs. I. H. Parsons, St. Elmo, Woodland Avenue, Leicester; Mrs. F. I. Levi, 154, Fosse Road South, Leicester; and J. N. Derbyshire, Bentinck Buildings, Wheelergate, Nottingham, chartered accountant. No initial public issue. The number of directors is not to be less than two nor more than seven; the first are A. W. Staveley, I. H. Parsons and W. Levi, each of whom may retain office while holding £2,000 ordinary shares; qualification of other directors, £500; remuneration as fixed by the company.

Chichester and District Electric Supply Co., Ltd. (78,784).—This company was registered on October 12th, with a capital of £20,000 in £1 shares, to carry on in the United Kingdom and elsewhere the business of suppliers of electricity for light, heat, sound and power, or otherwise, carriers of passengers and goods, electrical engineers, manufacturers of, and dealers in, railway, tramway, electric, magnetic, galvanic and other apparatus, &c. The first subscribers (each with one share) are:—C. H. Dade, Donington House, Norfolk Street, W.C., secretary of British Electric Traction Co., Ltd.; G. J. Somerville, Donington House, Norfolk Street, W.C., electrical engineer; G. Offor, Park Hill Villa, Sydenham, S.E., electrical engineer; G. R. Hulme, 43, Blackheath Park, S.E., electrical engineer; C. L. Robertson, Donington House, Norfolk Street, W.C., company director; H. S. Day, Donington House, Norfolk Street, E.C., director of Tynemouth and District Electric Traction Co., Ltd.; and A. B. Gridley, 15, Worsley Road, Hampstead, N.W., secretary. No initial public issue. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, one share; remuneration, £50 each per annum and 5 per cent. of the dividend on the ordinary shares divisible. Registered office, Donington House, Norfolk Street, W.C.

Piscicelli Electric Post Parent Syndicate, Ltd.—This company was registered on October 17th, with a capital of £150,000 in 60,000 £6 per cent. preference and 90,000 ordinary shares of £1 each, to acquire and turn to account an invention of Count Roberto Taeggi Piscicelli, of Naples, for an aerial electric post, with the patent rights for the same, and to carry on the business incidental thereto. The first subscribers (each with one share) are:—W. Digby, Trafalgar Buildings, Charing Cross, London, merchant; A. E. Griesbach, 17, Gloucester Road, Kew, accountant; H. E. Hyde, 44, Winchester Avenue, Brondesbury, clerk; Annie E. Howard, 46, Boron's Court Road, West Kensington, typist; A. C. C. Codd, Trafalgar Buildings, Charing Cross, merchant; I. C. Ozanne, 5-6, Court Road, Guernsey, accountant, and F. de P. Bienvenu, 1, Court Road, Guernsey, clerk. The first directors are Count R. T. Piscicelli (permanent), Le Duc de Morny (till 1905), Le Comte de Pradere (till 1905), H. S. Saunders (till 1905), and W. Digby (till 1905). Count R. T. Piscicelli is also technical director and constructional engineer.

West Surrey Light Railway Co., Ltd. (78,864).—This company was registered on October 19th, with a capital of £1,000, in 995 preference or "A" shares of £1 each and 100 ordinary or "B" shares of 1s. each, to provide and work a light railway or railways, tramway or tramways, in Surrey, and to carry on the general business of light railway proprietors, carriers of passengers and goods, &c. The first subscribers (each with 1 share) are:—J. B. Huvard, 3, Bedford Street, Strand, W.C., theatrical manager; B. Moore, 3, Brick Court, Temple, E.C., barrister; A. D. Thornton, 12, Clifford's Inn, E.C., property owner; T. G. Welch, 32, Egmont Street, New Cross, S.E., clerk; F. England, 27, Chancery Lane, W.C., insurance broker; J. G. Skeffington, 52, New Cut, S.E., butcher; and C. Hall, 51, Springfield Road, Hampstead, N.W., engineer. No initial public issue. The number of directors is not to be less than two nor more than five: the first are R. P. Gardner and C. Hall; qualification, 100 "A" or 10 "B" shares. Registered office, 27, Chancery Lane, W.C.

Lawrences, Ltd. (78,882).—This company was registered on October 21st, with a capital of £500 in £1 shares, to acquire the business of an electrical, mechanical and sanitary engineer now carried on at Spur Street, Leicester Square, W.C., as Lawrence & Co., to adopt an agreement with L. J. Lawrence, and to carry on the business of electricians, suppliers of electricity for light and other purposes, &c. The first subscribers (each with one share) are:—H. J. Lawrence, 94, York Street, Westminster, dealer in works of art; E. Allen, 6, Spur Street, W.C., electrician; C. Mitchell, 160, Arlington Road, N.W., clerk; T. Batt, 25, Ingelow Road, Queen's Road, Battersea, electrician; H. P. Simpson, 101, Leadenhall Street, E.C., mechanical engineer; Lily Feverel, 2, Princes Chambers, Coventry Street, dressmaker; and Mrs. V. Coleman, 44, Newington Causeway, S.E. No initial public issue. Registered without articles of association. Registered office, 6, Spur Street, Leicester Square, W.C.

Incandescent Lighting and Electric Fittings Co., Ltd. (5,464).—This company was registered in Edinburgh on October 20th, with a capital of £2,000 in £1 shares, to carry on in Glasgow or elsewhere the business of manufacturers of and dealers in gas and electrical fittings and furnishings of all kinds. The first subscribers (each with one share) are:—S. Rosenstein, 144, W. Nile Street, Glasgow, merchant; Bertha Rosenstein, 170, Parliamentary Road, Glasgow, merchant; C. Macdonald, 6, Steven Street, Glasgow, clerk; A. Schuh, 329, Great Western Road, Glasgow, furrier; J. Schuh, 329, Great Western Road, Glasgow, furrier; J. Stirling, 54, Parliamentary Road, Glasgow, ironmonger; and Mrs. B. Stirling, 54, Parliamentary Road, Glasgow. The first directors are not named.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Bath Electric Tramways, Ltd. (74,278).—A memorandum of satisfaction in full of a mortgage of uncalled capital, dated July 14th 1908, securing £10,000, has been filed.

Edmundson's Electricity Corporation, Ltd. (52,013.—An acknowledgment of indebtedness, dated September 28th, 1903, securing £100,000 debenture stock (supplemental to trust deed dated July 10th, 1899, and to three acknowledgments of indebtedness dated respectively April 27th, 1900, August 1st, 1901, and November 14th, 1902, securing debenture stock to an amount not exceeding three-fifths of the paid-up capital for the time being) has been registered. Property charged:—130 first mortgage debentures of £100 each of the Winchester Electric Light and Power Co., Ltd., 150 similar debentures of the Wycombe (Borough) Electric Light and Power, Ltd., 200 similar debentures of the Salisbury Electric Light and Supply Co., Ltd., 150 similar debentures of the Ventnor Electric Light and Power Co., Ltd., 100 similar debentures of the Bromley (Kent) Electric Light and Power Co., Ltd., 40 similar debentures of the Woolwich District Electric Light Co., Ltd., 50 similar debentures of the Chislehurst Electric Supply Co., Ltd., 40 similar debentures of the Newmarket Electric Light Co., Ltd., 50 similar debentures of the Alderley and Wilmslow Electric Supply Co., Ltd., and the company's undertaking and other assets, present and future. Trustees: J. Bailey, 104, Eaton Square, S.W.; and J. R. Wigham, Monkston, Dublin. Debenture stock previously issued, £200,000.

Connolly Brothers, Ltd., Cable Manufacturers, Blackley (46,277).—Issue on October 1st of £4,650 debentures, part of series created February 12th, 1900, to secure £30,000, charged on the company's undertaking and property, present and future, including uncalled capital. Trustees: J. B. Lloyd, Ravensdale, Stanley Road, Whalley Range, Manchester; and J. W. Davidson, 6, Castle Street, Liverpool. Previous issue of same series, £24,950.

British Continental Electricity Co., Ltd. (57,088).—This company's annual return was filed on September 25th, when 1,000 preference and 1,906 ordinary shares had been taken up out of a nominal capital of £20,000 in 1,000 preference and 1,000 ordinary shares of £10 each. £10 per share has been called up on 790 preference and 756 ordinary shares, resulting in the receipt of £15,460. £3,600 is considered as paid on 210 preference and 150 ordinary. Mortgages and charges, *nil*.

Halifax and Bermudas Cable Co., Ltd. (28,972).—This company's annual return, dated October 8th, 1903, has been filed. The entire capital of £50,000 in 10,000 shares of £5 each has been taken up and paid in full. Mortgages and charges: £62,500.

Direct West India Cable Co., Ltd.—The annual returns of this company up to and including October 8th, 1903, were filed on that date. £60,000 in shares of £5 each, of which £2 10s. per share has been called up. Debenture capital reduced to £57,800.

Halifax and Bermudas Cable Co., Ltd.—The annual returns of this company up to and including October 8th, 1903, were filed on that date. £50,000 in shares of £5 each, fully paid. Debenture capital reduced to £62,050.

Electrical Inkless Printing Syndicate, Ltd. (58,855).—This company's annual return was filed on August 11th, when 63,482 shares had been taken up out of a nominal capital of £70,000 in 70,000 shares of £1 each. 55,000 shares are considered as fully paid, and £1 per share has been called up on the remaining 8,482, resulting in the receipt of £8,475, and leaving £7 in arrears. Mortgages and charges, £830.

Electrical Corporation, Ltd. (62,630).—This company's annual return was filed on October 5th, when 3,007 shares had been taken up out of a nominal capital of £30,000 in £1 shares. £3,007 has been paid. Mortgages and charges, nil.

British Aluminium Co., Ltd. (41,104). — This company's annual return was filed on July 29th, when the entire nominal capital of £400,000 in 10,000 "A" 6 per cent. preference, 20,000 7 per cent. preference, and 10,000 ordinary shares of £10 each had been taken up. £10 per share has been called up on 10,000 "A" 6 per cent. preference, 16,770 7 per cent. preference and 8 ordinary shares, resulting in the receipt of £267,780. £132,220 is considered as paid on 8,230 7 per cent. preference and 9,992 ordinary. Mortgages and charges, nil.

Keighley Electrical Engineering Co., Ltd. (44,893).—This company's annual return was filed on October 9th, when 4,100 ordinary and 1,000 preference shares had been taken up out of a nominal capital of £10,000 in 8,000 ordinary, and 2,000 preference shares of £1 each. £1 per share has been called up on 4,000 ordinary, and 1,000 preference shares, resulting in the receipt of £5,000. 100 shares are considered as fully paid. Mortgages and charges, £3,000.

Bright's Light and Power, Ltd. (58,290).—A fifth mortgage debt for £500, dated October 8th, 1903, charged on all the company's concessions, freehold and leasehold works and plant in England and elsewhere, and (as a floating security) its other assets and undertaking in England and elsewhere, including uncalled capital (subject to first, second, third and fourth debentures securing in the aggregate £12,000) has been registered. Holder:—C. Owles, 16-17, Russell Street, Covent Garden, W.C.

Northampton Electric Light and Power Co., Ltd. (28,640).—Issues on October 9th, of £2,800 debentures, part of series created June 3rd, 1896, to secure not more than two-thirds of the subscribed and paid-up capital for the time being, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series, £28,250.

Frinton-on-Sea and District Electric Light and Power Co., Ltd. (70,689).—Issue on October 12th of £1,300 debentures, part of series created May 7th, 1903, to secure £3,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holders:—W. Webster and Miss A. A. Mackay, 50, Lee Park, Blackheath, S.E. No trustees. Previously issued of same series, £500.

Sherard Cowper-Coles & Co., Ltd., Electricians, &c, London (67,136).—Issue on October 12th, of £50 debentures, part of a series created by resolutions of December 3rd, 1901, and February 7th, 1902, to secure £6,500, charged on the company's property, present and future, except uncalled capital. No trustees. Previously issued of same series, £6,225.

ELECTRICITY SUPPLY ACCOUNTS.

Glasgow Municipal Electricity Supply.

The result of the past year's work of the Glasgow electrical department has been in every way satisfactory. The net profit amounts to over £23,000, as compared with some £11,000 in the previous year, notwithstanding heavy increases in special charges. Under the working agreement with the tramways department, 150,096 units were taken from them at the times of peak load, and during the coming winter an increased amount will be taken. The total units generated was as follows:—

Year.	Waterloo Street.	Port Dundas.	Pollokshaws Road.	Kelvinside.	Tramways dep't.	Total.
1902	1,498,609	8,471,008	1,014,635	138,354	—	11,122,606
1903	336,232	9,747,739	2,794,381	169,164	150,096	13,197,612

The total H.P. available was 17,580, which will be increased for this winter to 22,330. The question of hiring out motors, for which Parliamentary powers have been obtained, is now under consideration. Mr. W. A. Chamen is the city electrical engineer.

GENERAL STATEMENT.

For year ending May 31st—	1902.	1903.
Total capital expenditure	£962,727	£1,041,746
Number of units sold	9,282,043	11,501,324
Maximum load in KW.	7,950 KW.	9,371 KW.
Equivalent No. of 8-C.P. lamps	491,306	630,708
Number of public arcs	500	719
Horse-power of motors connected	3,086 H.P.	4,597 H.P.
Revenue account—		
Gross revenue	£103,940	£127,004
„ expenditure	£54,525	£58,667
„ profit	£49,415	£68,337
Average price obtained per unit—		
Private lighting...	2·8d.	2·7d.
Public lighting	1·91.	1·8d.

During the year consumers have increased by 31 per cent., and now total 7,013. The proportion of units sold were as follows:—

Year.	Private consumers.	Public lamps.	Contract.	Total.
1902	8,384,697	884,839	12,508	9,282,043
1903	10,419,488	1,064,404	17,432	11,501,324

The prices charged by the department are various:—For private lighting purposes (1) shops, offices, &c., on the maximum demand system, 6d. per B.T.U. for the first hour, and 1d. per unit (250-volt), 1½d. per unit (200-volt), 2d. per unit (100-volt), after that amount; (2) and (3) domestic consumers and theatres, 3½d. flat rate; (4) churches, 3d. per B.T.U. flat rate. For motive power, 1½d. to ¾d. per unit. Public lighting, £14 and £12 per annum for 10 and 7½ amp. lamps respectively. Stair lighting, 25s. to 37s. 6d. per lamp per annum, according to size.

REVENUE STATEMENT.

	1902. Gross.	1902. Per unit.	1903. Gross.	1903. Per unit.	Inc.
Sale of energy—					
Private consumers	£97,050	—	£118,844	—	—
Public lamps ...	6,890	—	8,160	—	—
	£103,940	2·78d.	£127,004	2·74d.	—·04d.

The works cost again show an improvement, although not so marked as in the previous year. The fuel item for the second year in succession is less in both total and per unit than in the previous year, being a decrease of £2,000, and ·08d. per unit; it now stands at ·27d. per unit.

Improvements have taken place all round, but are unfortunately to some extent nullified by a large increase in special charges, due to changing-over consumers to the higher voltage.

COST OF PRODUCTION.

For year ending May 31st—	1903. Gross.	1903. Per unit.	1902. Per unit.	Inc.
Coal, &c	£11,964	·27d.	·35d.	—·08d.
Energy purchased from tramway department	1,008	·02d.	—	·02d.
Oil, waste, water and engine room stores ..	2,143	·04d.	·05d.	—·01d.
Wages incurred in generation and distribution and attending public lamps	9,604	·20d.	·23d.	—·03d.
Repairs and maintenance of plant, cables and public lamps	13,598	·29d.	·37d.	—·08d.
Works and distribution costs	£37,717	·82d.	1·00d.	—·18d.
Rent, rates and taxes	6,814	·13d.	·15d.	—·02d.
Management expenses, including salaries of engineer and clerical staff	4,046	·08d.	·09d.	—·01d.
General establishment charges, printing, stationery and advertising	2,580	·05d.	·07d.	—·02d.
Special charges incurred in change of voltage, Parliamentary expenses, &c. ..	8,010	·17d.	·09d.	·08d.
Total works cost	£58,667	1·25d.	1·40d.	—·15d.

The gross profit for the year shows a handsome increase over that of the previous year. The department had to provide for financial charges, £45,000, as compared with £38,000 in the previous year, and it was decided to write off the loss on realisation of plant, dispensed with at Waterloo Street and Kelvinside station, owing to the change in supply voltage—amounting to £7,826—and to write down the capital account by £29,359, making a total of £37,185 written off for depreciation, and creating a debit balance on the year's working of £13,895.

PROFIT STATEMENT.

	1902.	1903.
Interest on loans	£29,416	£33,275
Sinking fund	8,568	11,771
Deficit on year's working	—	—13,895
Depreciation on works and machinery	11,431	37,186
Gross profit	£49,415	£68,337

Cardiff Municipal Electric Supply.

We give herewith an analysis of the returns of the Cardiff electrical undertaking for the last financial year. The Corporation commenced the supply of electricity in 1894, and up to the last two years steady progress was made. The years 1902 and 1903 have, however, seen a rapid development of the undertaking, and particularly of the supply for power purposes, and the resulting improvements in financial position must be a source of gratification both to the engineer, Mr. Arthur Ellis, and his committee. The progress of the undertaking during the last five years will be gathered from the following figures:—

Year.	No. of units sold.	Number of 8-c.p. lamps connected.	Average revenue per unit sold.	Total cost per unit sold.
1899	405,234	21,498	4·09d.	3·00d.
1900	511,300	28,000	3·92d.	3·07d.
1901	688,549	37,554	3·95d.	2·26d.
1902	1,005,760	51,852	3·62d.	2·08d.
1903	1,492,470	78,300	3·41d.	1·81d.

The charges are—for private lighting, 7d. and 2d. on the maximum demand system, or 4½d. per B.T.U. on a flat rate. Power rate, 4d. and 1d. on the maximum demand system. It will be noted that the department took a supplementary supply of energy from the tramways department.

GENERAL STATEMENT.

For year ending March 31st—	1903.	1902.
Total capital expended	£157,561	£119,566
Number of units sold—		
Private consumers	1,267,798	837,481
Public lighting	213,809	159,823
By contract	10,863	8,456
Total number of units sold ...	1,492,470	1,005,760
Equivalent No. of 8-c.p. lamps	78,300	51,852
Number of public lamps	224 arc, 98 inc.	78 arc, 78 inc.
H.P. of motors connected	458 H.P.	55 H.P.
Maximum load in KW.	1,372	951
Revenue account—		
Gross revenue	£21,157	£15,515
„ expenditure	11,271	8,704
„ profit	9,886	6,811
Average price per unit obtained—		
Private lighting...	3·5d.	3·8d.
Public lighting	2·4d.	2·9d.

REVENUE ACCOUNT.

For year ending March 31st—	1903. Gross.	Per unit.
By sale of energy	£20,703	3·33d.
Rental of meters and apparatus, &c. ...	454	·08d.
Total revenue	£21,157	3·41d.

COST OF PRODUCTION.

	Gross.	Per unit.
Coal, carriage, &c.	£2,932	·47d.
Energy supplied by tramways department ...	1,655	·27d.
Oil, waste, water and engine room stores ...	608	·09d.
Wages incurred in generation and distribution	1,622	·27d.
Repairs and maintenance of machinery, buildings and plant	1,558	·25d.
Works and distribution costs	£8,375	1·35d.
Attending and repairs, public lamps	466	·07d.
Rent, rates and taxes	912	·15d.
Management expenses, salaries of engineer and clerical staff	918	·15d.
General establishment charges, printing, stationery, insurance, &c.	600	·09d.
Total works costs ...	£11,271	1·81d.

PROFIT STATEMENT.

Interest and sinking fund	£6,238
Net profit for year	3,648
Gross profit	£9,886

Out of the gross profit of £9,866, financial charges absorbed £6,238, and a credit balance of £3,648 remains for the year. Sums of £500 and £2,332 are allocated to reserve and rates respectively, and with the balance of £2,256 from the last account, a total balance of £3,072 is carried forward.

CITY NOTES.

Norwich Electric Tramways Co.

The seventh ordinary general meeting of the company was held on Wednesday at 20, Bishopsgate Street. A representative of the Electrical Review was informed that the meeting was not open to the Press, but he was furnished with the following report:—"The subjoined accounts show that the gross earnings of the company for the year ended June 30th, 1903, amounted to £33,833 8s. 7d., and the working expenses to £24,204 14s. 1d., leaving a gross profit for the year amounting to £9,628 14s. 6d. To this have to be added the amount brought forward from last year of £824 3s. 5d. (after having paid 2 per cent. on October 22nd, 1902, or £4,840, and placing to reserve account £974 10s. 9d.), and £1,209 16s. 7d. interest received from the Corporation in final settlement of account, making a total of £11,662 14s. 6d. Deducting from this the sum of £2,640, being 4 per cent. interest on the company's outstanding mortgage debentures to June 30th, 1903, there remains a profit of £9,022 14s. 6d. The directors recommend that a dividend of 2½ per cent. be paid on the company's shares for the year ended June 30th, 1903, which would absorb £6,600, and that a sum of £1,209 16s. 7d. be placed to reserve account, the balance of £1,212 17s. 11d. being carried forward. The reserve account will then be increased to £2,184 7s. 4d. A comparison between the gross receipts for 11 months to June 30th and the receipts for the same period ending June 30th, 1902, shows that there was an increase of £497 15s. 4d., notwithstanding that the first months have shown a falling off of over £1,000. The working expenses for the same period show an increase of £699 2s. 9d. The average cost per car-mile was 5·43d. The average receipts per car-mile were 7·76d. The number of car-miles run was 1,045,901, and the number of passengers carried 7,173,420. Taking into consideration that the weather was again exceptionally bad during the spring and summer months, it is fairly satisfactory to think that the dividend can be increased, whilst the reserve is substantially increased, and the balance to be carried forward is larger than last year. Both the permanent way material and the track have been maintained in a state of satisfactory efficiency."

Ulster Electrical Power and Distribution Co.

A general meeting of this company was held on 21st inst., at the offices of Messrs. Preece & Cardew, Westminster, Mr. John Sinclair of Belfast, presided.

The engineers to the company produced their report on the scheme generally, and on the selection of sites, resulting from a recent visit of Mr. Llewellyn Preece to Ulster. From this report it appeared that the scheme will be very favourably received in Ulster, and that the needs of the industrial portion of the city of Belfast for such an ample power supply as this project will afford will be well and economically supplied. The question of utilising the water-power of the Rivers Bann and Erne was fully considered, and the extent to which the promoters could count upon active support from the Irish Executive, especially in view of the urgent question of flooding in the River Bann, and the probability of a method being devised whereby the utilising of the waters of that river could go hand in hand with the prevention of further flooding. The necessary instructions were given to the professional gentlemen regarding the promotion of the Bill and the acquisition of the sites. The scheme is well founded on a strong financial basis, and there is little doubt that it will give a great impetus to the industries in the north of Ireland. It was further decided to print and issue a statement of the various local authorities in Ulster, explaining the objects of the company.

Western Telegraph Co.

The directors' report for the half-year ended June 30th, 1903, to be submitted to the meeting on November 4th, reads:—

The revenue for this period amounted to £229,090 0s. 1d., and the working expenses to £94,791 8s. 0d. After providing £18,578 18s. 0d. for debenture stock and debenture interest and sinking fund, and £3,239 13s. 5d. for income-tax, there remains a balance of £117,480 0s. 8d.; to this is added the sum of £5,331 15s. 7d. brought forward from December 31st last, making a total of £122,811 16s. 3d. A quarterly interim dividend, amounting to £31,189 10s. 0d., has been paid, £35,000 transferred to the general reserve fund, and £2,000 to the maintenance ships' reserve fund. The revenue includes £14,790 1s. 0d. dividends upon the company's investments in other telegraph companies. The directors' now recommend the declaration of a final dividend of 9s. per share, making with the interim dividends, a total dividend of 6 per cent. for the year, and also the payment of a bonus of 2s. per share, both free of income-tax, which together will amount to £51,982 10s. 0d., leaving a balance of £2,689 16s. 3d. to be carried forward. The dividend and bonus will be payable on November 5th.

British Columbia Electric Railway Co.

The report for the year ended June 30th last states that there has been a large increase in the business in all departments, and in the profits. The gross receipts show an increase over the preceding year of $95,717, and the net earnings, after charging renewals, show an increase of $39,172. The following charges have been made against the revenue account of the year, namely:—Renewals maintenance, £10,446; bonus to employés, £1,494; written off preliminary and issuing expenses, £1,000; added to capital amortisation fund, £1,595. The net profit for the year, after making the above deduc-

tions, amounts to £37,865, and adding the balance brought forward, £533, and deducting debenture interest, the dividend on preferred ordinary stock for nine months to March 31st, 1903, and the interim dividend on the deferred ordinary stock for six months to December 31st, 1902, there is left available for distribution and reserves £15,779. The directors have decided to provide for the dividend on the cumulative perpetual preference shares to June 30th, 1903, to provide for the dividend on the preferred ordinary stock for three months to June 30th, 1903, to recommend a dividend on the deferred ordinary stock at the rate of 3 per cent., making 5 per cent. for the year, to transfer to contingency fund £1,000, and to transfer to reserve fund £3,000, leaving to carry forward £1,099. The construction of the Vancouver power installation by the Vancouver Power Co., Ltd., which commenced in July, 1902, has proceeded satisfactorily. The general manager reports that he expects the Power Co. will be in a position to deliver 2,000 B.H.P. by the beginning of December next. On the advice of the engineers, the scheme, as originally designed, has been enlarged, so as to provide for the supply of an initial 9,000 H.P., with power of expansion to 30,000 H.P., instead of an initial 6,000 H.P., with expansion to 15,000 H.P.; the size of the tunnel has been increased by 25 per cent., and machinery and transmission plant of greater electrical capacity are being provided. This enlargement of the original scheme will involve an additional expenditure of about £60,000, but the directors are satisfied that the importance of being fully prepared to meet the rapid increase in the demands for electrical power in Vancouver and New Westminster justifies the increased expenditure. Funds for carrying on the works of the Vancouver Power Co. have been raised by the sale of £175,000 4½ per cent. Vancouver Power debentures, part of a total authorised issue of £220,000, and the board propose at an early date to offer the remaining £45,000 to the stockholders and debenture holders to provide further funds as required.

Edison & Swan United Electric Light Co., Ltd.

The twentieth annual report of the directors for the business year ending June 30th, 1903, reads:—

"The directors submit herewith the report and accounts for the year ending June 30th, 1903, based upon the actual working of the whole period. The net revenue account shows that the sum of £30,834 18s. 5d. has been brought forward from profit and loss account. Interest on debenture stocks has absorbed £18,760 18s. 4d.; £5,690 4s. 2d. has been set aside as depreciation on freehold and leasehold property, plant, and machinery; £6,174 10s. 3d. has been applied in writing down values of stocks; and the sum of £1,168 10s. 3d. has been reserved on account of bad and doubtful debts. In pursuance of the policy inaugurated last year, a sum of £1,000 has been added to the reserve for future stock depreciation. The result, as shown in the balance-sheet, increases the debit balance by £1,959 4s. 7d. The cost of establishing the business, goodwill, &c., £443,451 8s. 1d., has been brought forward at the figures standing in the last balance-sheet. The freehold and leasehold property, plant, machinery and tools, have also been brought forward at the value stated in the last balance-sheet, with the addition of the amount expended to June 30th, 1903, less depreciation charged in net revenue account. The shares of the Altrincham Electric Supply, Ltd., have been taken at par, as in previous years. The indebtedness of this company has been reduced by £151 15s. 1d. There has been expended on capital during the year ending June 30th, 1903, £2,770 2s. 4d. The directors will continue to exercise a strict watchfulness on capital outlay. Mr. H. Wolfenden retires in rotation, and offers himself for re-election. Messrs. Welton, Jones and Co., the auditors, offer themselves for re-election."

Rosario Electric Co.—In their report to June 30th last the directors recommend a dividend on the preference shares at the rate of 6 per cent. per annum, calculated from the due dates of instalments to June 30th last, and that the preliminary expenses be written off, carrying forward £443.

British Aluminium Co.—An extraordinary general meeting is to be held on November 4th to consider the following resolution:—

That the capital be reduced from £400,000, divided into 10,000 "A" cumulative preference shares of £10 each, 20,000 preference shares of £10 each, and 10,000 ordinary shares of £10 each, to £310,000, divided into 10,000 "A" cumulative preference shares of £10 each, 20,000 preference shares of £10 each, and 10,000 ordinary shares of £1 each, and that such reduction be effected by cancelling capital (which has been lost or is unrepresented by available assets) to the extent of £9 per share upon each of the 10,000 ordinary shares which have been issued and are outstanding.

Prospectus.—An abridged prospectus of the *Whitehead Electric Supply Co., Ltd.*, was published in the *Irish Independent* on 21st inst. The list of applications for 7,500 £1 ordinary shares was to close on October 27th. Whitehead is a watering place and holiday resort in the vicinity of Belfast. It has only 250 houses, but is growing at a very rapid rate. The initial generating plant will be equal to supplying 3,000 8-C.P. lamps.

Stock Exchange Notices.—The Committee has appointed special settling days as under:—Thursday, November 5th: Peebles (Bruce) & Co., Ltd.—20,000 6 per cent. cumulative preference shares of £5 each, fully paid, Nos. 20,001 to 40,000. An official quotation has also been ordered.

STOCKS AND SHARES.

Wednesday Evening.

Apart from politics, the financial world has, for once in a way, but little to disturb it. The old familiar skeletons remain half visible it is true—a deep distrust of the situation in the United States, a plethora of gilt-edged securities, a lack of confidence that forbids active business—to such we have grown accustomed, and familiarity with their presence has bred a species of tolerance. Money remains easy and plentiful, but the cloud in the Far East shifts so quickly from day to day that Consols, and the markets that depend upon them, are crying a plague upon these politics. In the Home Railway market a steady liquidation on behalf of apparently weak speculators is responsible for the dull tone which prevails, although a recovery from the worst has already set in. Electrical Railway securities scarcely come within the speculator's ken, but prices are, of course, affected all round alike. Business in Supply shares and in the Manufacturing specialities shows signs of broadening, but the Telegraph descriptions seem to have settled down to respectable solidity after their recent upward spurt.

In the Electricity Supply section there is little noticeable feature beyond a general steadiness of values. Notting Hill shares and Westminster incline to dulness, and City of London Ordinary are no better than their par value of £10. Otherwise the strength of the market is maintained, and for several of the issues there has sprung up a quiet investment demand. We are glad to notice an esteemed contemporary following our footsteps in calling attention to the good yields that can be obtained from these Supply shares, both as regards Ordinary and Preference.

South Londons have paused in their rise upon its being pointed out that the large increase in receipts is due to a temporary cause, and in the market the guess is adventured that the company is probably having to supply the L.C.C. with current for the trams at a price that cuts the profit very fine. But this, of course, is only a surmise, although the House prophets generally manage to get shrewdly near the truth in such matters.

City and South London in the electrical railway list has stayed its downward course, in spite of the liquidation prevailing amongst the steam stocks, and Central London Ordinary is a point to the good. Travellers on the Twopenny Tube are complaining that the atmosphere is getting as bad as ever it was before the much-vaunted fan system came into operation. The company's 4 per cent. Debenture stock is now on a line with that of the City and South London, 116½, but the half-yearly interest on the latter falls due next Monday, November 2nd, while that on the other will not be paid until the middle of January. The City Preference trio are quoted at 128¼, 127½, and 124½ for the 1891, 1896 and 1901 issues respectively. The market in the last named is far from being a good one.

British Westinghouse Preference have improved to 5⅝, the recent tap of selling having been turned off. But British Electric Traction shares keep dull, and the Preference are easier at 11½, business being done at that price the other day. A few small orders in Cape Electrics have been negotiated about 2¼, but the tramway department is inanimate as a whole. Dublins at 12⅛, and London Preference at 11⅜ are practically unchanged. In the Colonial and Foreign list Anglo-Argentines keep at 4½, Barcelonas at 8, while the British Columbia Electric Railway issues exhibit no change, and Colombo Debenture stock is 103½. Calcuttas have lost ½ at 7. New schemes for electric propulsion are under consideration by the London General Omnibus directors, and the price of the company's stock is the round 100.

What alterations there are in the Telegraph market make for better prices, and the prior stocks continue to command most attention. African Direct Debentures have hardened a point, and so have Direct West India and West India and Panama Debentures. In the Anglo-American group, Submarines are a trifle harder, and Anglo Ordinary attracted attention by reason of the yield to be obtained from this very speculative investment, the quotation being 1 per cent. up. The Eastern varieties have virtually nothing to show in the way of fluctuation. National Telephone 3½ per cent. Debenture stock is slightly pressed for sale, and Oriental Telegraph Preference have come into the *Official List* for quotation, the price being 1 1/16 middle.

Amongst Manufacturing shares, British Aluminium Debenture stock has advanced a couple of points, and the Preference shares 10s., for the reasons to which we drew attention last week. It is now proposed to reduce the company's capital. Henley's have been done at 14. Babcock & Wilcox are 2⅞, Willans & Robinson 6, and the Preference marked 6¾ a day or two ago. Electrolytic Alkali Ordinary and Preference at 10s. and 15s. respectively, have not moved for weeks. Callender's are unaffected by the dividend announcement.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Oct. 21st.	Closing Quotations Oct. 28th.	Business done week ended Oct. 28th, 1903. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	98 —102	99 —103	..	..
25,600	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2⅛— 3⅛	2⅛— 3⅛	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	70 — 80	..	..
788,840	Anglo-American Telegraph	Stock	3⅛%	61s.	60/6	45 — 48 xd	46 — 49	47⅛	..
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	90 — 92	90 — 92	91¼	90½
3,105,580	Do. do. do. Deferred	Stock	5s. %	2s.	1/-	7⅛— 7⅜	7⅛— 7⅜	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	5 %	6 %	4⅜— 5⅛	4⅜— 5⅛	5	4⅞
13,333,300$	Commercial Cable	$100	8 %	8 %	8 %	145 —155	145 —155	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	90 — 93	90 — 93	..	..
16,000	Cuba Telegraph	10	4½%	4 %	6½%	7⅛— 8⅛	7⅛— 8⅛	8⅛	..
6,000	Do. 10 % Pref.	10	..	..	..	16⅛— 17⅛	16⅛— 17⅛	17 5/16	..
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	2⅜— 3⅜	2⅜— 3⅜	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7 — 8	7 — 8	..	..
80,000	Do. do. 4½ % Debs.	50	..	..	..	98 —102 %	98 —102 %	..	..
60,710£	Direct United States Cable	20	3½%	3½%	3½%	10¼— 10⅜ xd	10¼— 10⅜	..	..
87,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —102	99 —102	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	123 —128 xd	123 —128	125½	123½
1,955,565	Do. 5½ % Pref. Stock	100	..	..	..	89 — 92 xd	86 — 89	89	87
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	106 —109	106 —109	107½	107½
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	11⅜— 12⅛	11⅜— 12	11⅞	11⅞
320,000£	Do. 4 % Deb. Stock	Stock	..	..	..	104 —107	104 —107	..	..
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 3,000, red. 1909	100	..	..	..	99 —102	99 —102	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	100 —103 %	100 —103 %	..	..
180,227	Globe Telegraph and Trust	10	5½%	5½%	..	8⅜— 9⅛	8⅜— 9⅛	9	8⅜
180,042	Do. do. 6 % Pref.	10	..	..	..	12⅜— 13⅛	12⅜— 13⅛	13	12 1/16
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	15 %	12½%	22½— 23½	22½— 23½	22 1/16	..
62,500£	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —102	99 —102	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	10%	37 — 40	37 — 40	39	..
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	..	..	..	98 —102	98 —102	..	..
1,983,333	National Telephone, Pref. Stock	100	5 %	5 %	6 %	99 —101	99 —101	100¼	99
1,966,667	Do. do. Def. Stock	100	..	..	4½%	72 — 74	72 — 74	73½	72
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	14	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅞— 5⅛	4⅞— 5⅛	5	..
600,000£	Do. do. 5½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	93 — 95	92 — 94	..	..
600,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	102 —104	102 —104	..	..
179,313	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6 %	⅞— 1	⅞— 1	..	..
50,000	Do. do. do. 6 % Cum. Pref.	1	..	..	..	1 — 1⅛	..	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,839	Reuter's	8	5 %	5 %	..	6½— 7⅛ xd	6½— 7⅛	..	..
3,808	Submarine Cables Trust	Cert.	..	..	..	114 —119 xd	116 —121	..	..
68,000	United River Plate Telephone	5	7 %	7 %	7 %	5⅝— 6	5⅝— 6	5 9/16	5⅝
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4⅜— 5⅛	4⅜— 5⅛	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	104 —107	104 —107	..	..
15,609	West African Telegraph, Shares	10	..	..	2 %	5 — 6	5 — 6	..	..
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	..	..	..	95 — 98	95 — 98	..	..
267,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	7 %	12 — 12½	12 — 12½	12⅜	12⅛
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	100 —103	100 —103	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	98 —101	98 —101	..	..
88,321	West India and Panama Telegraph	10	½%	..	..	⅜— ½	⅜— ½	..	..
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6 — 6¼	6 — 6¼	6 7/16	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	3¼— 4½	3¼— 4½	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	100 —103	101 —104	103	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	4 — 5	4¼— 5⅛	..	..
800,000£	Do. do. 5% 1st Mort. Deb. Stock Red.	Stock	..	..	..	83 — 87	85 — 89	87	..
100,000	British Electric Traction	10	9 %	9 %	8 %	11⅜— 12⅛	11⅜— 12⅛	12⅛	11⅜
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	11 — 11⅛	11 — 11⅛	11 7/16	11⅛
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	120 —123	120 —123	122⅜	121½
100,000	British Insulated and Helsby Cables	5	15 %	10 %	10 %	6 — 6¼	6 — 6¼	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5¼— 5⅜	5¼— 5⅜	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	103 —106	102 —105	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	8 %	Nil	..	⅝— ¾	⅝— ¾	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	6 %	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	5 %	Nil	Nil	1⅜— 1½	1⅜— 1½	1	⅞
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	3 %	6 %	1¾— 1¾	1¾— 1¾	1⅞	1 15/16
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	97 —100	97 —100	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	85 — 90	85 — 90	..	..
85,000	Callender's Cable Construction shares	5	15 %	20 %	15 %	11⅛— 12⅛	11⅛— 12⅛	11½	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5⅛— 5⅜	5⅛— 5⅜	5⅜	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	106 —110	106 —110	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	..	4 %	4 %	94 — 97	95 — 98	96⅜	95 7/16
494,038	Do. do. 4 % Pref. Stock	Stock	..	4 %	4 %	99 —102	99 —102	99½	..
494,998	Do. do. Def. do.	Stock	..	4 %	4 %	99 —102	99 —102	..	..
1,330,000	City and South London Railway	Stock	1½%	2 %	3½%	51 — 53	51 — 53	52⅛	51½
85,000	Crompton & Co., Nos. 1 to 85,000	3	8 %	7½%	5 %	2 — 2½	2 — 2½	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	100 —104	100 —104	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £8 paid, 1 to 99,261	5	2½%	Nil	..	0 — ¼	0 — ¼	..	..
17,139	De. do. "A" shares, 01—017,139	5	2½%	Nil	..	1¼— 2⅛	1¼— 2⅛	..	..
344,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	72 — 77	72 — 77	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	76 — 81	76 — 81	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1⅛— 1⅜	1⅛— 1⅜	1⅜	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	..	..	..	2⅜— 3	2⅜— 3	..	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	97 —100	97 —100	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	9⅜— 10⅛	9⅜— 10⅛	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	96 — 99	96 — 99	..	..
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	20 %	14 — 15	14 — 15	14¼	14
35,000	Do. do. 4½ % Pref.	5	4½%	..	..	5 — 5⅛	5 — 5⅛	5 5/16	5 5/16
48,050	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	108 —112	108 —112	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	10 %	18⅜— 19⅝	18⅜— 19½	18⅞	18½
800,000£	Do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —103	100 —103	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	1½%	1½%	4⅜— 5⅞	4⅜— 4⅝	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	(10¼— 10⅜	10¼— 10⅜	..	..
37,350	Telegraph Construction and Maintenance.	12	17½%	20 %	20 %	34 — 37	34 — 37	35½	..
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	100 —103	100 —103	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3 %	3½%	93— 96	93 — 96	93	..

† Quotations on Liverpoo Stocks Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List

Bank rate of discount 4 per cent. (September 3rd. 1903).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Oct. 21st.	Closing Quotations Oct. 28th.	Business done week ended Oct. 28th, 1903. Highest.	Lowest
		‡							
100,000	Blackheath and Greenwich Dist. Electric Light, Ord...	1	..	..	..	⅝— ⅞	⅝— ⅞	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs.	100	..	..	..	116 —119	116 —119	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	5	6 %	8 %	8 %	10½— 10⅝	10½— 10⅝	..	..
20,000	Do. do. 7 % Cum. Pref. ..	5	..	..	..	10 — 10½	10 — 10½	..	..
60,000	Charing Cross and Strand Electricity Supply	5	9 %	10 %	10 %	9 — 9⅝	9 — 9⅝	9⅜	..
70,000	Do. do. do. 4½% Cum. Pref. ..	5	..	..	..	5⅛— 5⅜	5⅛ — 5⅜	..	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	5	..	..	..	4⅜— 5	4⅜— 5	..	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	104 —106	104 —106	104⅜	..
44,436	*Chelsea Electricity Supply, Ord.	5	5½%	4 %	4½%	5⅜— 6	5⅜— 6	5⅜	5⅜
150,000‡	Do. do. % Deb. Stock Red.	Stock	..	..	..	108 —111	108 —111	110	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595	10	0 %	5 %	5 %	10 — 10⅛	9⅜ — 10⅛	10⅛	
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	..	..	13 — 14	13 — 14	..	..
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	122 —127	122 —127	..	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	102 —105	102 —105	..	..
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000..	10	4 %	4 %	4 %	7⅜— 8⅛	7⅜— 8⅛	8	7⅞
20,000	Do. do. do. 6 % Pref., 40,001—60,000..	10	..	..	..	11⅛— 12⅜	11⅛— 12⅜	..	..
400,000‡	Do. do. 4½% Deb. Stock	..	..	..	..	107 —110	107 —110	109	108
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	..	..	..	100 —103	100 —103	102	101⅜
60,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	6⅜— 6⅜	6⅜— 6⅜	..	..
80,000	Do. do. 6 % Cum. Pref.	..	..	..	..	6⅛— 6⅜	6⅜— 6⅜	6⅜	6 7/16
140,000	Do. do. 4½% 1st Mort. Deb. Stock ..	100	..	..	..	105 —108	105 —108	107	105
21,000	Kensington and Knightsbridge Electric, Ord.	5	12 %	10 %	10 %	10½— 11⅛	10½— 11⅛	..	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	101 —104	101 —104	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	3	..	..	..	1⅜— 2⅛	1⅜— 2⅛	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	5⅛— 5⅜	5⅛— 5⅜	..	..
250,000‡	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	100 —102	100 —102	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6 %	6⅔%	7½%	17⅛— 18⅜	17⅛— 18⅜	17 13/16	17 11/16
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	5	..	..	..	3⅛— 3⅜	3⅛— 3⅜	3⅜	..
220,000‡	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	110 —114	110 —114	..	..
250,000‡	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	97 —100	97 —100	..	..
10,852	Notting Hill Electric Lighting	10	7 %	6 %	6 %	13 — 14	12⅛— 13⅛	12⅜	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14⅜— 15⅛	14⅜— 15⅛	14⅞	..
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	..	..	..	8 — 9	8 — 9	8 3/16	8⅛
150,000‡	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	97 —100	97 —100	99	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	..	2½%	3 — 3⅛	3 — 3⅛	..	..
65,000	South London Electricity Supply, Ord.	5	..	..	1¾%	3⅞— 4	3⅞— 4	..	..
80,000	Urban Electric Supply, Ord.	5	..	..	..	4⅜— 5⅛	4⅜— 5⅛	..	..
80,000	Do. do. 5 % Cum. Pref.	5	..	..	..	4⅜— 5	4⅜— 5	..	..
110,000	Westminster Electric Supply, Ord.	5	10½%	10½%	12 %	12⅜— 13⅛	12 — 13	12⅛	12⅜
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6 — 6⅜	6 — 6⅜	6 5/16	..

*Subject to Founders Shares. ‡Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, October 28th.

CHEMICALS, &c.

		Latest Price.	Week's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a ,, ,, ...	per ton	£30	..
a Bleaching powder	per ton	£4 10	..
a Bisulphide of Carbon	per ton	£15	..
a Borax	per ton	£13	..
a Benzole (90 %)	per gal.	7/-	..
a ,, (50/90 %)	per gal.	5/6	..
a Copper Sulphate	per ton	£20	..
a Lead, Nitrate	per ton	£24	..
a ,, White Sugar	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	..
a Potash, Bichromate, in casks ..	per lb.	3d.	..
a ,, Caustic (75/80%)	per ton	£24	..
a ,, Bisulphate	per ton	£35	..
a Shellac	per cwt.	200/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a ,, Crystals	per ton	£8	..
a ,, Bichromate, casks	per lb.	2½d.	..

METALS, &c.

b Aluminium Ingots, in ton lots ..	per ton	£130	..
b ,, Wire, in ton lots ..	per ton	£168	..
b ,, Sheet, in ton lots ..	per ton	£166	..
p Babbitt's metal ingots	per ton	£48 to £130	..
e Brass (rolled metal 2" to 12") basis	per lb.	7d.	⅛d. inc.
e ,, Tube (brazed)	per lb.	9d.	⅛d. inc.
e ,, ,, (solid drawn) ..	per lb.	7 7/16d.	⅛d. inc.
e ,, Wire, basis	per lb.	7½d.	⅛d. inc.
c Copper Tubes (brazed)	per lb.	9¼d.	⅛d. inc.
c ,, ,, (solid drawn) ..	per lb.	9⅜d.	⅛d. inc.
g Copper Bars (best selected ..	per ton	£73	£5 inc.
g Copper Sheet	per ton	£73	£5 inc.
g ,, Rod	per ton	£73	£5 inc.
e ,, (Electrolytic) Bars ..	per ton	£67	£2 inc.
e ,, ,, Sheets ..	per ton	£77	£2 inc.
e ,, ,, Rod ..	per ton	£69	£2 inc.
e ,, ,, H.C. Wire	per lb.	8¼d.	⅛d. inc.
f Ebonite Rod	per lb.	3/3	..
f ,, Sheet	per lb.	3/-	..
n German Silver Wire	per lb.	1/6	..
h Gutta-percha fine	per lb.	3/-	..
h India-rubber, Para fine	per lb.	4/3 to 4/5	..
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	42/8	10d. dec.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g Lead, English Ingot	per ton	£11 10 to £11 12 6	5s. inc.
g ,, ,, Sheet	per ton	£13	..
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£8 7 6	..
d Mica (in original cases) small ..	per lb.	4d. to 1/6	..
d ,, ,, ,, medium	per lb.	2/6 to 3/9	..
d ,, ,, ,, large ..	per lb.	4/- to 7/9	..
p Phosphor Bronze, plain castings	per lb.	1/- to 1/2½	..
p ,, rolled bars & rods	per lb.	1/- to 1/3	..
p ,, ,, strip & sheet	per lb.	From 1/1	..
o Platinum	per oz.	£4	..
p Silicium Bronze Wire	per lb.	9d. to 11d.	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block	per ton	£122 10 to £123 10	50/ to 70/ inc.
g ,, Foil	per lb.	1/6	..
n ,, Wire, Nos. 1 to 16	per lb.	1/6½	½d. inc.
p White Anti-friction Metals— "White Ant" brand ..	per ton	£42 to £62	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j ,, 6 lea. Flax	per lb.	5½d.	..
j ,, 3 ply 10 lbs. Russian ..	per lb.	4 11/16d.	..
j ,, 10 lbs. Russian, single ..	per lb.	4½d.	..
j ,, 180 lbs. Jute rove	per ton	£11	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£23 15	..

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co.; *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RECEIPTS.

	Locality.	Week ending	Receipts for the week. £	£*	Total to date. £	£*	Miles open.	*
	Aberdeen	Oct. 24	1,141	+315	27,223	+ 4,142	10	—
	Birmingham	,, 24	5,193	— 0	218,861	+ 9,095	—	—
	Bournemouth	,, 23	921	—	—	—	10½	—
	Blackburn	—	—	—	—	—	12½	+1½
	Blackpool	,, 22	417	+ 15	34,902	— 225	8½	—
	Blackpool and Fleetwood	,, 24	255	— 10	18,977	— 150	7½	—
	Blackpool and Lytham ..	,, 22	237	+128	12,546	+ 6,847	—	—
	Bolton	,, 25	1,745	+105	56,493	+ 7,225	25	—
	Bradford	—	—	—	—	—	41	+4
	Brighton	,, 25	810	— 8	42,683	—	6½	—
	Bristol	,, 23	4,860	+ 395	—	—	28	—
	Burnley	,, 24	822	+134	—	—	7½	—
British Elec. Trac. Co.	Barnsley District	,, 16	177	—	7,525	—	4½	—
	Devonport	,, 16	489	+ 59	18,979	+ 870	5	—
	Dudley—Stourbridge..	,, 16	799	+ 35	34,968	+ 3,414	18⅝	—
	Gateshead	,, 16	915	+ 41	36,175	+ 4,903	10½	+ ⅜
	Gravesend—Northfleet	,, 16	234	+ 24	10,139	+ 969	3½	—
	Greenock—Pt. Glasgow	,, 16	559	+ 53	22,924	+ 1,758	7½	—
	Hartlepool	,, 16	263	+ 43	11,347	+ 611	6½	+2
	Kidderminster	,, 16	110	— 7	5,464	+ 178	4½	—
	Merthyr	,, 16	204	+ 14	8,369	— 191	3	—
	Middleton	,, 16	262	+ 15	13,338	+ 1,668	8½	—
	Oldham—Ashton ..	,, 16	544	— 19	28,805	+ 1,534	6	—
	Peterborough	,, 16	132	—	6,257	—	—	—
	Poole	,, 16	282	+ 35	12,928	+ 1,389	5½	—
	Potteries	,, 16	1,702	— 5	65,158	+ 3,413	28½	—
	Rothesay	,, 16	51	— 9	6,596	+ 1,603	2½	—
	Sheerness	,, 14	63	—	2,623	—	2½	—
	Southport	,, 16	290	+ 56	13,374	+ 2,455	6½	—

* Compared with the corresponding period of 1902.

	Locality.	Week ending	Receipts for the week. £	£*	Total to date. £	£*	Miles open.	*
B.E.T. Co.	South Staffordshire ..	Oct. 16	954	+189	37,459	+ 5,652	21⅜	— ⅜
	Swansea	,, 18	514	+ 42	21,728	+ 1,815	5½	—
	Taunton	,, 16	59	+ 3	2,584	— 198	1½	+1½
	Tynemouth	,, 16	287	— 43	13,522	+ 820	3⅜	—
	Weston-super-Mare..	,, 14	53	— 8	5,418	— 491	2⅜	+2⅜
	Wolverhampton Dist.	,, 16	383	+ 72	16,318	+ 7,343	10⅜	+8
	Wrexham	,, 16	140	—	4,107	—	—	—
	Yorks. Woollen Dist...	,, 16	465	—	12,693	—	6	—
	Cardiff	,, 24	1,927	+422	60,236	+17,380	14	—
	Chatham & District Co.	,, 15	570	+ 39	22,372	+12,933	8·53	—
	Dover	,, 24	185	— 16	9,709	+ 97	3	—
	Dublin	,, 23	4,607	+190	91,186	+ 7,585	46½	+ ½
	East Ham	,, 24	629	+149	20,792	+ 6,168	5	+ 1
	Glasgow	,, 24	13,898	+1354	288,426	+31,764	66	+ 9
	Hull	,, 24	1,883	+155	56,277	+ 2,800	11	+ 1
	Ilkeston	,, 21	146	—	—	—	4	—
	Isle of Thanet	,, 24	358	— 49	30,780	— 1,583	10½	—
	Leeds	,, 24	5,320	+410	169,951	+10,499	41	—
	Liverpool	,, 17	10,242	+264	424,090	+14,021	106	—
	Manchester	,, 24	11,500	+6161	355,542	+216,945	72	—
	Newcastle	,, 24	3,644	+608	—	—	17	—
	Portsmouth	,, 24	1,463	+ 84	—	—	29	—
	Salford	—	—	—	—	—	30	—
	Southampton	,, 22	967	+ 6	—	—	9	—
	Sunderland	,, 25	1,088	+ 39	38,519	+ 1,948	20	+3
	Central London Railway	,, 24	6,737	—506	104,320	— 5,590	6	—
	City and S. London Ry.	,, 25	2,946	—811	43,080	— 6,635	6½	—
	Dublin and Lucan Elwy.	,, 25	98	— 10	2,879	+ 158	6½	—
	Liverpool Overhead Ry.	,, 25	1,659	+ 91	28,765	+ 1,924	6	—

THE GLASGOW MUNICIPAL TELEPHONE SYSTEM.

Facts and Figures.

III.—Working Expenses.

In our last article we showed, by a detailed examination of the plant of the Glasgow municipal telephone system, as it is described and valued in the Glasgow Corporation telephone accounts, that the annual charge for depreciation should amount to about £20,000, and that even if sinking fund were taken to represent depreciation, there would still be an omission of between £11,000 and £12,000 from the debit side of the revenue account. This would bring the total cost of furnishing the service, including interest and sinking fund, up from £33,320 to some £45,000. Even this, however, does not tell the whole story. The working expenses proper, apart from interest and sinking fund, are shown in the accounts to be £20,871 2s. 2d. A close examination of this part of the accounts, and a comparison with the statistics, give rise to some interesting speculations as to how far the accounts really represent the actual working expenses.

The comment in the special report of the auditors, entering a mild protest against the unusual procedure of charging to capital expenses incurred in canvassing for new subscribers, was sufficient to arouse suspicion, and the remarkably low figures given for working expenses are well calculated to confirm it. In the total working expenses of £20,871 2s. 2d. is included an item of £1,497 15s. for terminal fees. This is a charge that has to be met out of revenue, while not actually forming a part of the expense of operating the service and maintaining the plant. The same remark applies to Post Office royalty, which amounts to £3,405 9s. 8d. Deducting these two amounts from the total expenditure, we have £15,967 17s. 6d. for the sum total of actual working expenses at Glasgow.

The number of lines at May 31st, 1902, was 4,745, and the number at May 31st, 1903, was 7,441, giving an increase of 2,696. Taking the mean of the increase, 1,348, and adding to 4,745, we get 6,093 as the average number of lines in operation during 1903. Rounding this off to 6,100, and dividing into £15,968, we get £2 12s. 4d. for the average annual working expenses per line. Such a remarkably low figure as this for a large city system is a little too good to be readily accepted without very substantial and convincing proof of its accuracy. The accounts are necessarily too much in abstract to furnish any such proof, but an analysis of them, in conjunction with the statistics, affords, not proof of the accuracy of the figures, but reasonable grounds for the assumption that they are, to say the least, not sufficiently comprehensive.

Even making every allowance for cheap wayleaves, cheap rents and other incidental savings that may lie within the power of a corporation to secure, it is not easy to see how this extremely low working cost can be arrived at. To make the matter perfectly clear, we give below the items of which this sum of £15,965 17s. 6d. is made up.

Working Expenses at Glasgow.

	£ s. d.	£ s. d.
Inspection and repairs—		
Wages	3,327 11 4	
Materials, &c.	1,044 3 5	
		4,371 14 9
Reconstruction—		
Wages	214 12 1	
Materials, &c.	60 2 0	
		274 14 1
Post Office Commissions	... ...	21 5 3
Trunk and telegram fees	... ...	9 17 11
General expenses—		
Postages	183 9 7	
Petty expenses	35 1 1	
Sub-Exchange petties	22 3 6	
Miscellaneous	104 12 0	
Town clerk's fee fund	150 0 0	
Auditor's fee	31 10 0	
Wayleaves	146 9 8	
Salaries, wages and allowances ...	6,890 1 10	
		7,563 7 8
Printing, stationery and advertising...	... ...	685 6 1
Rents, rates and insurance	... ...	2,789 10 3
Fuel and light	... ...	252 1 6
Total actual working expenses ...	...	£15,967 17 6

This is a complete transcript of the expenditure side of the revenue account, less the two items of Post Office Royalty and terminal fees, which we will leave on one side for the present. It will be noticed that the wayleaves form an extremely small item, averaging less than 6d. yearly per line. This economy in wayleaves, always an expensive item with private companies, is about the most striking advantage that Corporation ownership can claim. It is, however, at the worst, a relatively small proportion of the total cost of working.

The account may be divided up into the following four general items:—

Wages	£10,432 5 3
Materials, &c.	1,104 5 5
Rents, fuel, &c.	3,041 11 9
Miscellaneous	1,389 15 1
Total	£15,967 17 6

The remarkable point is the small amount of wages paid, considering the size and extent of the system. Here we have a city telephone system, serving a large area, with 17 exchanges, over 15,000 miles of metallic circuit line, a mean number of 6,100 subscribers' lines and 7,200 stations, operated for a whole year with a wages bill of only £10,432 5s. 3d., or just over £200 a week. How is it done? If it really *is* done, the Glasgow Corporation would seem to have solved a problem almost as important as that of perpetual motion—the problem of getting work done without pay. The real explanation, however, is to be found, we think, in the method of accounting for salaries and wages and of allocating them to capital cost and working expenses. A consideration of the staff employed, and a comparison of the total wages bill with the total wages charged to working expenses, go a long way to show that in dealing with their telephone department the Glasgow Corporation have, on paper, economised in working costs at the expense of the capital account. This is not a wholly novel method of finance, and there are companies of all kinds that are not innocent of such methods. But it is unsound, as any method of book-keeping is unsound that does not show clearly the real state of affairs.

In the present instance the total payment for salaries and wages is not given in the accounts or statistics, but the staff is set forth in fair detail, and the total wages paid can be estimated with reasonable accuracy. The staff is as follows:—

Salaried officials	12
General office	25
Stores office	8
Operators	192
Canvassers	8
Engineers and draughtsmen	14
Clerks in engineers' offices	10
Cleaners	9
Fitters, inspectors and boys in inside superintendent's department	105
Inspectors, foremen, wiremen, labourers and boys in outside superintendent's department	213
Total	596

The staff shows a net decrease of 32 since May 31st, 1902, when it numbered 628. The principal decrease has taken place in the construction force, the "outside superintendent" having now a force of 213 as against 315 last year. There are also reductions in the engineering force. There was an increase of 71 in the operating staff, and slight increases in the office force, the net result being, as we have said, a reduction of 32 in the total staff.

We have made a careful estimate of what the total payment in salaries and wages to this force is. We have in every case taken current rates of pay, and then, in deference to the well-known parsimony of municipalities in such matters, have made a general reduction of 10 per cent. This liberal discount helps us out in another matter. Municipal telephone management has a strong partiality for boys, apprentices, "improvers" and green hands generally, and, of course, we are unable to do more than guess at the number of this class of employé in the above total. But, presumably, there must be a fair stiffening of grown men and experienced hands in each department, and we think, in taking off 10 per cent. from the total estimated wages, that we are making

a fair allowance for all the economical tendencies of municipal management.

With all care and every allowance we do not estimate the total payment of the Glasgow Corporation telephone department for salaries, wages and allowances during the year under review at less than £29,500. Unless every other man on the staff is a boy, this must be rather under than over the real figure. This figure gives an average of under £1 a week for every member of the staff, including all overtime, special duty, travelling allowances, &c., and as less than a third only of the staff are operators, who are the only large class of the staff that will average much less, the gross figure we have arrived at cannot be far wrong. If it errs appreciably we are fairly confident that the error will be found on the right side, as we have taken special pains to estimate as closely as possible. Most of our readers familiar with rates of pay and with the conduct of large businesses will agree that a staff of the numbers and character described could not be maintained for less than the annual sum we have named. Under commercial conditions, with efficiency the prime object, the amount would be several thousands more.

Well, of this total of £29,500 for salaries, wages and allowances, all that we find debited to working expenses is £10,432 5s. 3d., or 35·3 per cent. Out of the total wage bill, over £19,000 has been charged to capital expenditure. According to general experience the proportions should be the other way about, and of the total wage bill about 65 per cent. should be charged to working expenses and about 35 per cent. to construction. It is true that this would give the revenue account an appearance that would be distinctly unfavourable, as it would give a balance on the wrong side of some £8,000. That, of course, would provoke so much hostile comment in the Glasgow Town Council, where the telephone accounts have already been criticised with much severity, that it is not to be thought of, and the only method that has been found of purchasing a year or two of comparative peace is to charge working expenses to capital. In no other way could the service be carried on and a balance brought out on the right side of the revenue account; and on no other hypothesis can we account for the unduly high capital cost of the system, in view of the comparatively cheap character of the plant.

Although most telephone men of experience will agree with us that of the total cost for salaries and wages about two-thirds is due to working expenses and about one-third to construction, it may be urged that the Glasgow system is only in its second year of working, and that much new construction is still going on. True, the system is only in its second year of working, but it is the third year of construction, and nearly three-fourths of the capital expended had been spent at May 31st, 1902. At that date the capital account stood at £192,693, and during the year under review the addition to the capital account has been £78,556, showing that the amount of new construction during the year has not been very great. Moreover, the statistics for staff show that the outside staff — the division chiefly occupied in new construction—was reduced from 315 in 1902 to 213 in 1903, a reduction of 102 men; this shows that the new construction work done by the department itself in 1903 was on a greatly reduced scale. It will be interesting to see just how the £78,556 of new capital spent in 1903 was laid out, as the items give some guide to the amount of labour involved to the department itself :—

Capital Expenditure from June 1st, 1902, to May 31st, 1903.

1. Underground construction	£29,743	13 11
2. Overhead construction	15,362	19 1
3. Central exchange construction	14,253	18 5
4. Sub exchange construction	3,170	10 4
5. Instrument construction	14,513	19 0
6. Public telephone offices	626	10 10
7. General expenses (canvassing)	527	14 11
8. Furniture and fittings	357	2 4
	£78,556	8 10

Of these eight items Nos. 1, 3 and 4 are practically all contract work, in Nos. 5, 6 and 8, the value is practically all in the material, and No. 7 has no business in a capital account at all; leaving No. 2, overhead construction, as the principal item involving much work on the part of the department itself. Assuming that, on this account, 40 per cent. of the total cost is in labour, which is liberal, there would be £5,700 in wages here. There were 3,643 instruments added to the system, and £1,200 would cover the labour in items 5 and 6. On the underground construction, although all the work is usually done by contract, the Department may have done some work itself on the distributing cables; we will allow £2,500 for this. We then get for labour costs, after eliminating items 3, 4, 7 and 8, as follows :—

Underground construction	£2,500
Overhead construction	5,700
Fitting instruments	1,200
Supervision and office expense, 10 per cent. on £9,400	940
	£10,340

According to this estimate, which, under the circumstances, is a liberal one, the total amount of salaries and wages which should have been charged to construction is a little over £10,000, instead of the sum of over £19,000 which, apparently, actually was charged. The difference, between £9,000 and £10,000, should have gone to working expenses. It is, in our opinion, quite preposterous to charge to capital account some £20,000 in salaries and wages on a total expenditure of £78,000, of which considerably more than half is represented by work let out to contract, and much of the rest is represented by the value of the material. There can be little doubt but that this method of book-keeping goes some way towards explaining the inflated capital cost shown in our first article.

There is one more illustration from the accounts that helps to prove this point. Necessarily, we can adduce only circumstantial evidence of our contention that the working expenses are being favoured at the expense of the capital account, but this is a particularly interesting and convincing piece of circumstantial evidence. Of the total amount of £10,432 5s. 3d. for salaries and wages charged to working expenses, as shown above, £3,542 3s. 5d. are accounted for under inspection and repairs and reconstruction, the balance of £6,890 1s. 10d. coming under general expenses as "Salaries, wages and allowances." This sum of £6,890 1s. 10d. includes not only the operators' wages, but all office force of all kinds, supervision and general management. The operators were 121 in 1902, and 192 in 1903. Taking the average number of operators employed throughout the year as 160, their total pay-roll, including supervisors, night operators, chief operators, and so on, would be about £5,000 for the year. A large proportion of learners and juveniles may bring it a trifle lower, but not much. This leaves the large sum of £1,890 for the salaries and wages of all the other employés engaged in the actual conduct of the business. If our readers will look over the list of the staff printed above, they will readily see the application of the remark, and can calculate for themselves how far £1,890 will go among salaried officials, office force in various departments, superintendents, cleaners, &c.

In order to summarise our views on the real working expenses of the Glasgow Corporation telephone system, we will now proceed to reconstruct the revenue account from the above data, as follows :—

Glasgow Corporation Telephones.

Estimated Revenue Account, 1902-3.

Dr.		Cr.	
Working expenses as shown in accounts.	£15,967 17 6	Total revenue	£35,014 2 9
Salaries and wages now charged to capital which should be charged against revenue (say)	9,000 0 0	Deficit ...	21,499 5 0
Post Office royalty ...	3,405 9 8		
Terminal fees ...	1,497 15 0		
Depreciation and sinking fund ...	20,000 0 0		
Interest on capital...	6,642 5 7		
Total ...	£56,513 7 9		£56,513 7 9

This statement, showing a loss of £21,500 on the year's working instead of a balance of £1,694, or a total difference of £23,194, much more nearly represents, in our opinion, the true condition of the Glasgow Corporation telephone finances than the accounts presented to the

Glasgow Town Council. It means that the *average* revenue per subscriber's line should be over £8 instead of about £5.

ENGINE AND DYNAMO BREAKDOWNS.

As usual, Mr. Longridge's annual report is full of interest. It deals with the breakdowns of engines insured by the Engine, Boiler and Employers' Liability Insurance Co., and in several cases the explanation of failure is accompanied by a statement of the probable number of stress applications. Thus a big-end bolt failed at 207 million

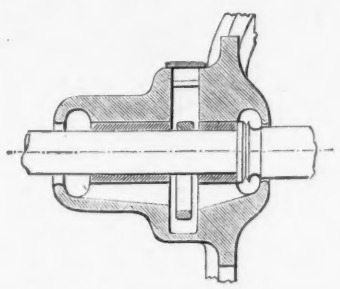


Fig. 1.—Section of Bearing.

revolutions, a cross-head cap bolt at 98 millions. A main beam showed a crack at 270 million revolutions of its engine, while a badly-fitted crankpin, the crank-eye being shrunk on the pin-shank, which was smaller than the pin, failed after 342 million stress applications or 171 million revolutions. A fly-wheel burst because the knock-off motion failed to act owing to its having been fixed badly, as pointed out to the owners, who heeded not.

When will people learn that a gas engine jacket should be fed with soft water? A gas engine failure is attributed to deposit in the jacket. Another jacket failed from freezing, thereby emphasising the need of drain cocks to empty it in frosty weather. A gas engine crankshaft very properly broke near the driving fly-wheel. There was a fly-wheel at the other end of the shaft to help the breakage to occur, the immediate cause being lack of alignment. Two bearings only are strongly advised.

The boiler section of the report still leaves room for wonder at the callousness with which costly boilers are allowed to be corroded by acid water. Thus six large boilers

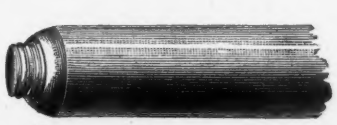


Fig. 2.—Broken End of Spindle.

laid down new in 1900 for 160 lbs. pressure required new internal flues by the end of 1902. A contrast to this is the case of a Lancashire boiler made in 1884, which was not reflued until 1901. It had iron flues. Another of unknown age is still fit for its 80 lbs. pressure; this also has iron flues, while a third in the same range, made in 1899, had new flue plates in 1902, and locomotive boilers fed with the same water and made of iron remain sound, while steel locomotive boilers on the same water again have soon to be renewed. Steel seems unable to bear bad water.

Potential brittleness is a feature rather of thick than thin plates, and we are told this undesirable quality may occur even where ordinary chemical and mechanical tests give seemingly good results. Of the 12,000 boilers insured in 1886, 44·7 per cent. were Lancashire type and 22·6 per cent. were Cornish. Now, out of 12,000 boilers similarly analysed, 44·7 are Lancashire and 18·2 are Cornish. Plain cylindrical boilers have decreased from 12·1 to 3·5 per cent. Water-tube boilers increase from 0 to 1·6 per cent. Locomotive type boilers have increased from 3·6 to 9·8, and verticals from 15·2 to 20·0, an increase probably due to fear of the law rather than to any actual growth of that class of boiler. The average pressure of 50 lbs. in 1878 is probably 90 lbs. in 1902. No surprise will be felt at the explosion of a cast-iron superheater.

Finally, a Diesel engine test is reported, one result showing less than 0·5 lb. of oil per B.H.P.-hour, the oil being crude Texas.

Dealing with electrical machinery, Mr. Longridge states that the number of minor breakdowns has been reduced, and assigns as the cause the system of periodical inspection, as the number of breakdowns due to accidents (*i.e.*, to causes which inspection could not forestall) has risen from 13 per

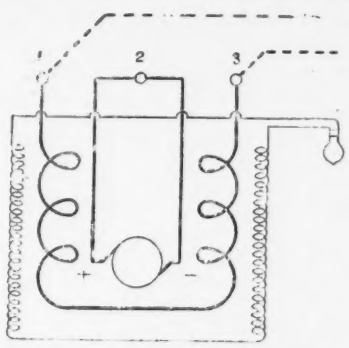


Fig. 3.—How not to Couple up a Dynamo.

cent. in the case of dynamos, and 7 per cent. in that of motors in 1901, to 17 and 13 per cent. respectively in 1902. Breakdowns vary in frequency according to the work performed by the machinery; for example, while the annual rates of breakdown among insured dynamos and motors in general have been 1 in 12 and 1 in 8 respectively, the rate among machines working at collieries has been 1 in 3, and among coal-cutter motors 1 in 2. The actual results are very interesting, and are, therefore, reproduced below:—

Analysis of the year's breakdowns:—

	Dynamos.	Motors.
Accident	17 per cent.	... 13 per cent.
Dirt or neglect	25 „	... 18 „
Deterioration	15 „	... 26 „
Bad workmanship or design	15 „	... 15 „
Overloading	5 „	... 13 „
Unascertained	23 „	... 15 „
	100	100

The parts which failed first:—

	Dynamos.	Motors.
Armatures and rotors ...	68 per cent.	... 54 per cent.
Magnet coils and stators	9 „	... 16 „
Commutators and brush gear	12 „	... 21 „
Miscellaneous	11 „	... 9 „
	100	100

Amongst other curious accidents the following may be of interest:—A wood-screw, attracted by the magnet poles of a two-pole dynamo, got between the pole-face and the armature, short-circuiting some of the conductors. A small screw-key was plucked out of the hand of a passer-by and damaged the armature of a dynamo. A series-wound motor driving a centrifugal pump attained an excessive speed, and the armature conductors, flying out of the grooves, were jammed so tightly between the core and the poles that the armature had to be driven out in small pieces. A motor having broken down, it was found that the shaft was fractured owing to a V-groove having been cut in it to prevent the creeping of oil along the shaft; it need hardly be pointed out that this is a totally wrong proceeding, as it is both ineffective and injurious. Several breakdowns occurred through the armature spiders of motors being merely jammed tight against a shoulder by a nut on the spindle—no key being used. A case is recorded of the starting current of a 2-H.P. motor on 110 volts rising to 105 amperes. Perhaps the most singular case of all is the following:—On starting a 2-H.P. motor, 3½ years old, the attendant was, not

unnaturally, surprised to see that while the armature revolved as usual, the pulley remained stationary! On examination, he found that the armature spindle had been completely worn through by the brass lubricating ring, which was, nevertheless, in good condition and free from wear. The oil used was free from acid, and no further explanation was available. Figs. 1 and 2 on page 717 show this extraordinary break. Examples of accidental earths, incorrect connections, and damage by dirt, copper dust, coal dust and oil are common; starting resistances are sometimes connected in *parallel* with the motors, and in the case of a compound-wound dynamo, the brush terminals were joined together, the shunt winding was connected to nothing but a glow lamp, and the ends of the series winding were coupled to the external circuit, as shown in fig. 3. "No wonder," says the Inspector, "the dynamo failed to generate!"

It seems that to insure one's dynamos and motors is a cheap and good way of having them kept in order; for in numerous instances the Inspector not only located the causes of trouble, but personally rectified them and started the machines before he left the premises. The great value of such capable and intelligent inspection, not only to the owners, but also to the electrical industry, cannot be questioned, and we wish all success to the Engine, Boiler and Employers' Liability Insurance Co., so ably served by Mr. Longridge.

TESTS OF THE EDISON STORAGE BATTERY.

From a report recently made by Mr. W. Hibbert on tests in England of the Edison storage battery, the following details and curves based on the data of the tests were recently published in the *Electrical World and Engineer*:—

The standard automobile cell is of rectangular shape. It stands 13 in. high (over all), measures 5·1 × 3·5 in. horizontally, and weighs 17·8 lbs. It contains 14 positive and 14 negative plates. Each plate is made of sheet steel, nickel-plated, punched with 18 rectangular holes. In each of these

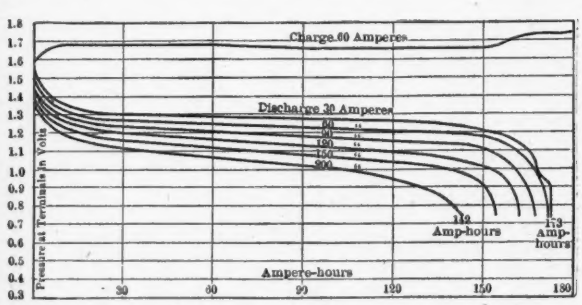


Fig. 1.

holes is inserted a flat pouch or pocket containing the active material. The walls of these pockets are perforated by exceedingly fine, short slots, through which the liquid can penetrate. Thus the current can easily pass to and from the active material contained in the pocket.

Both positive and negative plates are alike, except in respect of the active material. The pockets in the negative plate contain finely-divided iron; those in the positive contain peroxide of nickel. The liquid is a 20 per cent. solution of potash. This suffers no change during the action of the cell, except the loss of a small quantity of water, which is decomposed whilst the cell is being charged. A small quantity of electrolyte suffices, as it acts merely as an electrolytic conductor, and not as an active material in the ordinary sense. The plates may, therefore, be fixed very near each other, for the narrow intervening space allows an adequate supply of potash solution.

The proximity of the plates does not apparently involve danger of short-circuiting. The plates are thin, but, being made of steel, their rigidity is exceptionally good. Mechanical stability is further assured by vulcanised rubbed separators, the whole forming a compact mass, calculated to resist all the ordinary mechanical shocks it is likely to undergo.

The only special mechanical difficulty which seemed probable was the chance that the gases evolved during a "charge" might eject some of the active material from the pockets. During the test, therefore, the pockets were watched carefully, especially during very heavy charges, but without any evidence of loss.

The cell is sealed in its steel case. Two stout connecting pins (from the positive and negative plates respectively) come through liquid-tight bushings of vulcanised rubber. These pins are made slightly conical, as are also the connectors which fit on them, and the mechanical finish and easy grip of this terminal add to the value of the battery. On the

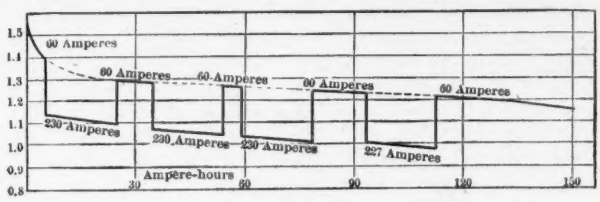


Fig. 2.

top of the case there are also a spring stopper with rubber flange, covering the hole by which the electrolyte is introduced, or distilled water added from time to time; and a vent hole guarded by a gravity valve. This latter provides for the escape of the gas evolved during charge. The hole and valve are covered by a gauze nipple, which prevents escape of spray while allowing gas to pass. Acting on the principle of Sir Humphrey Davy's safety lamp, the same gauze further prevents any chance of explosion should a flame be brought near to the exit.

The E.M.F. is 1·33 volts. The internal resistance is 0·0013 ohm. The output at 60 amperes is 210 watt-hours, or at the rate of 11·8 watt-hours per lb. of cell. The discharging value at high rates of discharge rises to many times the normal. The cell suffers no appreciable polarisation, and, therefore, recovers its normal voltage almost instantaneously when the current returns to an ordinary value.

In the accompanying curves, fig. 1 shows the pressure during discharge. Each line corresponds to a constant current, the discharge rates varying from 30 to 200 amperes. This last is a high rate for a cell of this size, but the experiment proved that the cell could stand it without injury. It took the succeeding charge in an excellent way, and yielded the 30-ampere curve immediately afterwards. At 120 amperes the output was 91 per cent. of the maximum. Even at 200 amperes, the quantity (ampere-hours) is 82 per cent. of the maximum.

In fig. 2 are given the results of one out of many experiments, intended to test the flexibility of the cell. The standard cell was discharged, starting at 60 amperes. After a time (5 minutes) the current was suddenly increased to 230 amperes. A little later the current was reduced again

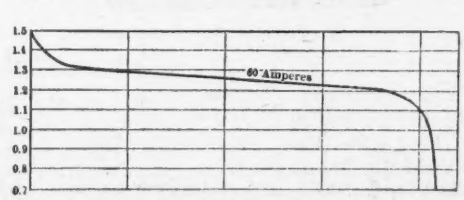


Fig. 3.

to 60, and so on, as shown by the curve. The cell yielded this great current for short intervals and recovered almost instantaneously. It does not appear to be injured in any way, and subsequent charging and discharging seemed to be quite normal.

An important point in traction cells is the rate at which they can be charged. Experiments on this point demonstrated that the Edison cell will absorb 70 to 75 per cent. of its full charge in one hour. Fig. 3 shows the result of one of these experiments. The cell was charged for one hour only, at the excessive rate of 175 amperes. It was then discharged and gave data for the curve. This shows that it absorbed and could deliver 124 ampere-hours out of the 175 put into it at this very great rate.

After three months' work, with very many charges and discharges, the capacity of the cells remains the same as at the beginning. It has neither increased nor diminished. Examination of the plates after three months' work does not indicate any signs of corrosion. The plates are as even in surface and as rigid in strength as at the beginning.

The standard cell was sent to England from America *viâ* Paris, and, therefore, underwent two trans-shipments, together with many loadings and unloadings, and journeys by rail and road. This long and varied journey was made in its ordinary working condition, the plates and fittings in the case fixed as in use. The only difference was that the cell travelled without the liquid, so that the plates were more or less exposed to air.

On its arrival, having in it no liquid except that which had trickled off the plates to the bottom, it was joined to a voltmeter, and gave 1·33 volts. The full quantity of electrolyte was then put in and the cell given a first charge and discharge. The output following this first charge was 174 ampere-hours, a figure identical with that obtained after further treatments.

GAS-PIPE v. COPPER.

By C. ALFRED SMITH, B.Sc., A.I.E.E.

The vast improvement made of recent years in the construction of the gas engine, and the success with which units of at least 1,000 B.H.P. have been run, together with the advent of what is commonly called "power gas," have fixed the attention of electrical engineers upon this method of generating electricity.

There is one aspect of the question, however, which seems to have been overlooked, although, it is true, a few months ago an admirable discussion (introduced by Prof. Burstall, M.A., M.I.C.E.), before the local section of the I.E.E. at Birmingham, set many thinking of its possibilities. It is the transmission of power gas in the place of electricity.

Agreed that in the large cities there is a great demand for power in the form of electricity, power which *must* be supplied in that form for traction and lighting purposes, it by no means follows that the methods of supplying that power now in vogue are the most economical. On the contrary, the author is of the opinion that in some cases, especially for a completely new scheme, such as that which must shortly replace the somewhat antiquated methods now in vogue in Birmingham, it would be worth while considering the generation of electricity in bulk by means of Mond gas and gas engines. But it is sometimes dangerous to take individual cases, local characteristics and enterprise vary so much; it may be of more value to assume that there is yet left a city with half a million inhabitants and covering a very large area, the population of which are engaged in manufacturing industries (*i.e.*, a city with a good motor load) and to briefly consider the best present-day method of supplying this city with electricity.

Electrical engineers, as a body, fight shy of gas engines. The early failures of Belfast and other places still rankle in their minds, and seem ever present in their memories. The alluring reports from the Continent, even the gas engine makers' guarantee that they can supply units of 2,500 B.H.P., which will run three-phase alternators in parallel, all fail to eradicate the prevailing impression that gas engines are not altogether reliable for central station use. Many who would trust them for driving continuous current generators in parallel would refuse the responsibility of selecting them for three-phase work. But why use alternating currents on such a scheme? Is it certain that the usual practice of generating high-tension alternating currents and transmitting the same to sub-stations, there to be converted into direct current for traction and lighting purposes (*e.g.*, as at Glasgow and Manchester) is the cheapest and best? Is it not, at any rate, simpler—and all other things being equal, simplicity will appeal to the engineer—to build a large central station at some convenient site for the generation of power gas (instead of electricity), to transmit that power gas through piping to sub-stations, and there to use it for driving gas engines of a reliable size—say up to 1,000 B.H.P.—for generating the continuous current needed? Instead of using the fairly expensive coal compulsory for the satisfactory working of steam boilers, and making steam for driving steam engines, which in turn drive alternators for generating electricity in *a form which is not wanted for ordinary purposes*, which electricity is sent some miles along very expensive and highly insulated copper cables to a complicated and again *expensively* equipped sub-station, where it is stepped down (with the accompanying losses) before it can be used with the rotary converter (in some sub-stations it is true the "stepping down" is omitted, by using motor-generators) which machine is again a source of loss in power, especially at light loads—why not use gas pipes and gas engines?

Comparisons have been ably drawn by Mr. Humphreys (*Proceedings of the Institution of Mechanical Engineers*) concerning the cost of running gas engines and steam engines for generating purposes, and most engineers who have studied these classical papers are convinced that, on the score of economy, the gas engine wins. "But," most of them say, "With the generation of electricity in bulk, gas engines are impossible." Is it certain that what is required in bulk *is* electricity—is it not power? Electricity is essential for *distributing* purposes—the transmission and the distribution of power must not be confused.

The Alternative Scheme.

Briefly, and in all humility for a theory which has never yet been proved in practice, the author advances the suggestion of an alternative method of generation and transmission of power. Instead of steam boilers and the steam engines, the usual three-phase H.T. alternators, &c., at the generating station, erect a large power gas station, with its accompanying ammonia recovery plant, its opportunities for the use of cheap "slack," and its, comparatively speaking, negligible coal bill and generate power gas. The author has not the slightest interest—other than technical—in any of the methods of making power gas, and so leaves the selection of the particular method to the common-sense and judgment of the reader, but he believes the cheapest and most reliable to be the invention of Dr. Mond. In place of the expensive *underground* cables (for it is obvious that, if overhead transmission were permissible in England, the comparison would be much more in favour of electrical transmission, although even then gas would not be out of the running) lay down a length of gas piping to carry to the sub-station, containing gas engines and continuous current generators, sufficient power gas to meet the maximum load. Compressors would be needed to give the gas sufficient initial velocity, but the initial cost and the cost of running such compressors would be much less than is usually supposed to be the case. In fact, high compressions and high initial velocities do not pay if the gas is to be delivered at the "sub-station" at atmospheric pressure. Much might be said in favour of a scheme which would use power gas as compressed air is used in Paris, obtaining a certain amount of work out of the gas at the sub-station by virtue of its high pressure, and then using it, when it had expanded down to atmospheric pressure, in a gas engine. But, for the sake of simplicity, the author refrains from considering the complexities and the possibilities of such a scheme. Perhaps it might pay to deliver the gas at a greater pressure than atmospheric direct to the gas engine; such points would stand discussion. For the present the following figures give the cost of a compressor working with a mechanical efficiency of ·8, for transmitting 6,000 B.H.P. for a distance of 5 miles, and assuming that the gas engine consumption per B.H.P.-hour is 70 cb. ft. In such a case the author has calculated that the diameter of the main necessary is 1 ft. 4½ in., while the initial velocity of the gas is 55 ft. per second—quite a permissible velocity. The initial pressure required is 1½ atmospheres; for the final pressure to be atmospheric, this is, perhaps, not absolutely the most economical compression, but it may be taken as correct that for distances of three to five miles high compression does not pay, *i.e.*, the increased cost of the piping due to low compression is less than the additional initial cost of working the compressor due to high compression. At 1½ atmospheres the "line" efficiency is 95·9 per cent., and the I.H.P. for compressor is

257. Taking the cost of the compressor at £7 10s. per I.H.P., the capital cost of such a machine is a little under £2,000. The next important capital cost to be determined is the cost of the main. For the pressure of 1½ atmospheres a riveted steel pipe ⅜ in. thick might be used. It will be seen, then, that if the price of the piping be taken at £7 10s. a ton, the cost of the piping will be ·15d. × (diameter in feet) per foot run. Taking the cost of the metal at x £'s per foot run, in order to keep a formula which will allow for the fluctuation of the market, the piping will be £(·02d.) x per foot run. Taking such a main, however, at £7 10s. per ton of metal, the cost for a length of five miles and diameter 1⅜ ft. = £5,444. If the metal cost £9 per ton, the cost becomes £6,522. The cost of laying the main must, of course, be included in the estimate, and allowing for a trench with 1 ft. top and bottom and sides clearance of the pipe, for flanges, &c., then the area of trench is $(d + 2)^2$ sq. ft. A fair cost for such work is 2s. 9d. per cubic yard complete, which gives a cost of excavation for the above line five miles long at £1,504. So that the total cost of the excavation and main itself—metal at £7 10s. per ton, excavation at 2s. 9d. per cubic yard—becomes £6,948. The actual cost of the compressor, estimated previously, works out at £1,927, so that the total capital cost for "line" equals £8,875.

It is difficult to come at such "cost" figures very exactly, but assuming that the piping costs £9 a ton in place of £7 10s., the "line" cost then totals up to £9,953. And since this is the "capital cost" for a line for transmitting 6,000 B.H.P., it must be acknowledged that this is very small. For longer distances a greater compression is needed, and later the figures for a 20-mile transmission will be given. The previous figures will no doubt be challenged; however, the cost of running the compressor will, in all cases, be included, under the assumption that Mond gas can be manufactured at a little more than 1d. per 1,000 cb. ft. at the central station. And since the South Staffordshire Mond Gas Co. guarantee to supply the gas to consumers at some distance from the generating station—*i.e.*, they will pay for the piping, and presumably obtain a profit, for 2d. per 1,000 cb. ft.—this manufacturing cost should be quite possible.

On the five-mile transmission, if the interest and depreciation on the "line" capital expenditure is taken at 10 per cent., then the annual "line" cost, excluding the cost of working the compressor, is £887 5s. If we assume that the gas used for driving the compressor can be made at the central station for 1·07d. per 1,000 cb. ft.—a figure arrived at on the basis of Mr. Humphreys' calculations in his papers previously alluded to—then, taking a 25 per cent. load factor on the 6,000 B.H.P., and the consumption of gas at 70 cb. ft. per B.H.P.-hour, the cost of running the compressor is £179 per annum. This gives a total line cost of £1,066 per annum. In other words, gas which can be generated at the central station at a cost of 1·07d. per 1,000 cb. ft. can be delivered to the sub-station in sufficient quantity to supply 6,000 B.H.P. at 25 per cent. load factor, at this total of £1,066 per annum.

Assuming the 25 per cent. load factor, there will be metered at the L.T. bus-bars of the gas engine sub-station about 8 million B.O.T. units per annum, allowing an efficiency of the generator $\frac{(\text{E.H.P.})}{(\text{B.H.P.})}$ of ·8. Therefore, the line cost works out at approximately ·03d. per B.O.T. unit. The electrical efficiency of the generator is probably taken at too low a figure; but on the basis of the above calculations the remarkably low figure, ·03d. per unit, is obtained.

The figure £7 10s. above quoted should include cost of riveting and jointing of pipes. But even assuming a figure double this amount, and allowing for considerable leakage of gas from the pipes, the cost per unit can hardly exceed ·05d.

On an electrical transmission scheme using underground cables, and 10,000 volts (sub-station end) three-phase transmission, the cost of the cables may be approximately calculated. For this class of work the current density worked at will be taken at 1,000 amperes per sq. in., which means a drop of 42·2 volts per mile on each wire of the three-phase line, or 211 volts on 5 miles. So that the generator voltage must be $1{,}000 + \sqrt{3}\,(211) = 10{,}365$ volts, which gives a high "line" efficiency.

In the case of the gas main the calculations for diameter, &c., were made for the maximum load to be supplied to the sub-station, *i.e.*, 6,000 B.H.P. Now it is fairly certain that the efficiencies of the transformers and the rotaries will not be more than ·8 (the efficiency assumed for the dynamos to which the gas engines were coupled in the gas engine sub-station scheme). And consequently the cables must be of sufficient size to deliver at least 6,000 E.H.P. to the electrical sub-stations to obtain the same maximum load at the low-tension bus-bars, as in the previous case. Therefore, the power per phase is 1,492 KW. at 5,770 volts per phase to neutral points, if star connected, and the sectional area of copper for each phase (at a current density of 1,000 amperes per sq. in.) = ·2585 sq. in. So that the total area of copper for three-phase = ·7755 sq. in. if the power factor equals 1. Taking the power factor at ·95, the area becomes = ·8162 sq. in. Now, the copper for this latter sectional area weighs 7·42 tons per mile. Assuming one cable in four spare—or, say, a total sectional area of 1 sq. in.—the cost of such cable will be found to come out at about £7,000 per mile, or £35,000 for 5 miles. The cost of the ducts, trench work and laying will come to £1,400 per mile, or for five miles £7,000, making a grand total for cable when laid of £42,000.

Taking the same interest and depreciation as on the gas-pipe line—*i.e.*, 10 per cent.—we get the electrical "line" costs at ·126d. per unit, as against ·03d. to ·05d. for gas. Since the cost of running the compressor was included in the alternative scheme, the cost of generating the wasted units for the "line" losses in this one should be added to this £4,200 per annum. Nor does that complete the case for gas transmission—from a cost point of view. It has been pointed out by many competent authorities that the cost of running a gas engine station is far less than that of running a steam engine station. On the other hand, it has been pointed out—among others, by Mr. Earle—that beyond a certain point centralisation does not pay. The advantages of using these gas engine sub-stations include that of a lower wages bill, for under ordinary circumstances attendance is compulsory at the generating station for the prime movers, switchboard, &c., as well as at the electrical sub-stations. Under the new conditions the staff required at sub-stations would be less than the staff employed for sub-stations and central stations in present-day large schemes. The obvious fact that there would be a considerable demand for power gas for heating and metallurgical purposes has been left out of consideration in all the above calculations. Take this into account, and the "line" costs for the gas main compare even more favourably.

There are few engineers who would hesitate to replace the large steam-driven units for gas engines if they could be convinced that the latter would run as sweetly as the former at the larger horse-powers. And yet, from other results which the author has obtained, he ventures the opinion that, owing to the great saving in capital "line" costs and electrical machinery, as well as in attendance, it would pay to use this method of gas engine sub-stations rather than generate at a central station of, say, 50,000 I.H.P. with gas engine units of 5,000 I.H.P. (if the latter could do everything that the steam sets of the size can do in the way of parallel running, &c.), and transmit electrically. The notion may be pooh-poohed by electrical experts—especially cable manufacturers—but the ardent electrical engineer, anxious to obtain the B.O.T. unit at the lowest possible cost, will, at least, carefully consider the problem. And in the long run it will be the electrical engineer who will gain by the increased demand for electricity which will follow a reduction in price.

FAILURE OF ELECTRIC SUPPLY.

[FROM A LEGAL CONTRIBUTOR.]

EVERY electric lighting company or local authority authorised to supply current to consumers within a district is compelled to maintain the supply without inter-

mission, subject to severe penalties. Perhaps there is no provision in the electric lighting Acts more important to undertakers than this. Its strict observance involves the employment of workmen at the central station day and night, the provision of a large stock of coal, of spare sets of generators and of machinery which is capable of suddenly coping with any increased demand which may be made upon it owing to the sudden approach of thick fogs in the district. In London, for instance, the day often opens up brightly with the result that but few lamps are used, and the engineer naturally allows some of his fires to remain damped down. A pea-soup fog suddenly settles down, and every consumer turns on his light, with the result that a severe strain is put upon the machines which happen to be running. In these circumstances suppose there is a break-down, what is the consequence to the company?

The question leads us to the consideration of those provisions of the electric lighting Acts which compel undertakers to give a continuous supply.

It is provided by Sec. 30 of the schedule to the Electric Lighting Clauses Act that (1) whenever the undertakers make default in supplying energy to any owner or occupier of premises to whom they may hand are required to supply energy under the special order, they shall be liable in respect of each default to a penalty not exceeding 40s. for each day on which the default occurs.

Taken by itself, this clause imposes a very serious liability upon a company or local authority supplying electricity, for it would extend to every default which they might make. Even if the supply were cut off for a few minutes in the day, it might involve them in a claim for penalties. Its rigour, however, as we shall presently see, is modified by a subsequent clause.

In cases where the local authority are not themselves undertakers, severe penalties are inflicted if there is any failure to supply energy to public lamps. Sub-sec. (2) provides that where the local authority are not the undertakers, and the undertakers make default in supplying energy to the public lamps to which they may be and are required to supply energy under the special order, the undertakers shall be liable in respect of each default to a penalty not exceeding 40s. for each lamp *and* for each day on which the default occurs. Sub-sec. (3) provides that whenever the undertakers make default in supplying energy in accordance with the terms of the Board of Trade regulations, they shall be liable to such penalties as are prescribed by the regulations in that behalf.

The fourth sub-section is of the greatest interest. It runs: "Provided that the penalties to be inflicted on the undertakers under this section shall in no case exceed in the aggregate in respect of any defaults not being wilful defaults on the part of the undertakers, the sum of £50 for any one day, and provided also that in no case shall any penalty be inflicted in respect of any default if the Court are of opinion that the default was caused by inevitable accident or *force majeure*, or was of so slight or unimportant a character as not materially to affect the value of the supply."

Nice questions sometimes arise as to what constitutes *force majeure*, which is sometimes described in legal documents as "the act of God or the King's enemies." In a case which was heard in Dublin in 1899, it was proved that the supply of energy had broken down owing to certain defects in a cable which had not made themselves apparent for a considerable time. It was held that the company were excused on the ground of inevitable accident (Sun Insurance Co. *v.* Dublin Corporation, December 9th, 1899). But the defence of *force majeure* or inevitable accident will not avail a company in every case. In Shaddich *v.* London Electric Supply Corporation, in 1900, the keeper of certain licenced premises at Deptford summoned the defendant corporation for failure to supply electricity to his premises. The default was admitted, but the defence was *force majeure*, it being contended that the supply of electricity having become deficient owing to unavoidable causes, it became essential that some part of the district of the company should be cut off, and that Deptford was selected as causing the least public inconvenience. The full penalty of 40s. was inflicted in each of the seven cases, with 20 guineas costs in the first case, and 2s. costs in each of the others. It would seem, however, that where the company are taken by surprise, and asked to supply a number of consumers for whom they have not made adequate arrangements, they will be leniently dealt with. Thus in the Marylebone Vestry *v.* Metropolitan Electric Supply Co., Electrical Review, January 5th, 1900, p. 13, the company were summoned by the vestry and guardians for making default in supplying electrical energy to the workhouse and vestry premises on certain days. The company admitted the default, and contended that the same was due to inevitable accident, caused by the great increase in the demand for electricity which had exceeded their expectations. The case was at first adjourned and eventually small fines were imposed.

It would seem that if any negligence on the part of the company can be proved, it is futile for them to urge a plea of *force majeure* or inevitable accident.

Thus the faulty laying of a cable which led to a break owing to subsidence; defective insulation leading to short circuit; carelessness at the central station which led to a stoppage of all the machinery; none of these things could be pleaded in answer to a summons for failure to supply. On the other hand, the breakage of a cable owing to floods, the bursting of a boiler, or sudden stoppage of machinery owing to some undetected fault, would always be received as a complete answer to a charge of failing of supply. But it is essential, in the interest of the consumer, that the company should take every precaution to secure that even when one set of engines breaks down another shall be ready to take its place.

PRACTICAL EXAMPLES WITH THE CALCULATOR BOARD.

By EDWARD RAYMOND-BARKER.

Series I.—*Notes for Submarine Cable Staffs.*

(*Continued from page* 654.)

[Owing to the large number, and great diversity of examples obtainable from the C.B. electrical curve sheet, the writer feels constrained to hold over a certain number until the Electrical Review C.B. articles re-appear in hand-book form, when those examples now omitted will be given *in extenso* Hence the present omission of Examples 6, 7, 8, 9, 10, 12, 15, and figs. 15, 16, 17, 18, 19, 21 and 24.]

Example 3:—Given batteries of 19, 38, 74, and 93 cells Leclanché (1·485 v. per cell.) Required equivalent in Fuller bichromate cells (2·00 v. per cell).

$$\frac{1{\cdot}485 \text{ v.}}{2{\cdot}000 \text{ v.}} = 0{\cdot}743.$$

Answer:—19 × 0·743 = 14 bichromate cells.
38 „ „ = 28 „ „
74 „ „ = 55 „ „
93 „ „ = 69 „ „

Example 4:—Solution of

$$K = \frac{\sqrt[13]{n}}{\sqrt[13]{n-1}}.$$

In the course of a test on a broken cable, solution was required of Schaefer expression:—

$$K = \frac{\sqrt[13]{n}}{\sqrt[13]{n-1}}, \text{ where } n = \frac{17{\cdot}32 \text{ ma.}}{4{\cdot}127 \text{ ma.}} = 4{\cdot}197.$$

Ordinate:—Scale for n, viz., G_3.
Abscissa:—Scale g_4.

Bring H.C. to 4·197 (*i e*, close under 4·20) on scale for ratio n, viz., scale G_3.

To point where H.C. intersects curve $\frac{\sqrt[13]{n}}{\sqrt[13]{n-1}}$,

bring V.C., so that H.C., V.C., and curve intersect each other at a point common to the three.

On scale g_4, plainly indicated on curve-sheet as appertaining to above formula, read answer 1·49 = K (fig. 13).

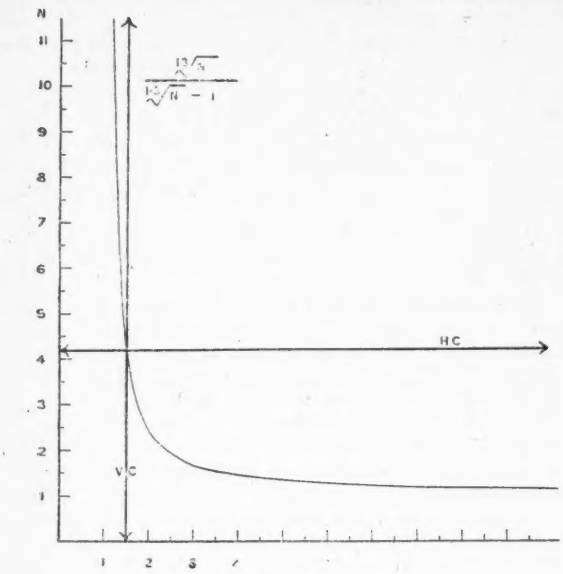


Fig. 13.

Example 5 :—Check accuracy of Example 4 by finding value of

$$\sqrt[1\cdot3]{n} = \sqrt[1\cdot3]{4\cdot197}$$

by operation of cursors.

Ordinate :—Scale for n, viz., G_3.

Abscissa :—Scale g_4.

Bring H C. to 4·197 (in practice just under 4·20) on scale for ratio n, viz., scale G_3 (fig. 14).

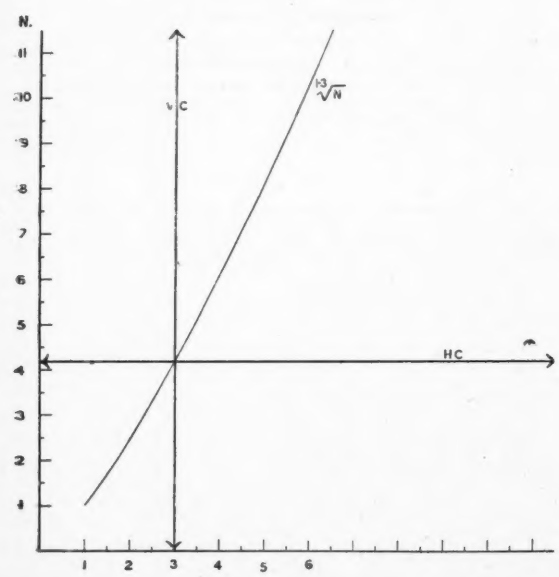


Fig. 14.

To point where H.C. intersects curve $\sqrt[1\cdot3]{n}$, bring V.C. so that H.C., V.C., and curve $\sqrt[1\cdot3]{n}$ intersect at same point.

On scale g_4, at index of V.C., read answer 3·01.

$$\text{Then } K = \frac{\sqrt[1\cdot3]{n}}{\sqrt[1\cdot3]{n} - 1} = \frac{3\cdot01}{3\cdot01 - 1} = \frac{3\cdot01}{2\cdot01} = 1\cdot498.$$

Just for the purposes of these notes, in order to afford proof of a sufficient degree of accuracy in the working of the cursors over the curve in question, let a check be made by calculation.

$$K = \frac{\sqrt[1\cdot3]{n}}{\sqrt[1\cdot3]{n} - 1}$$

$$n = 4\cdot197 = \frac{\text{log.}}{0\cdot62294} \div 1\cdot3 = \frac{\text{log.}}{0\cdot47920}$$

$$= 3\cdot0144.$$

$$K = \frac{3\cdot0144}{3\cdot0144 - 1} = \frac{3\cdot0144}{2\cdot0144} = 1\cdot4964.$$

Temperature Coefficients.

The calculator board sheet bears a curve based on Messrs. Clark, Forde & Taylor's determination of the true temperature coefficient for copper.

Given a difference in degrees Fahr. between any two temperatures, the action of the cursors indicates the figure by which the resistance in ohms of any given copper wire must be multiplied or divided, as the case may be, to correct a resistance from a lower to a higher, or from a higher to a lower temperature.

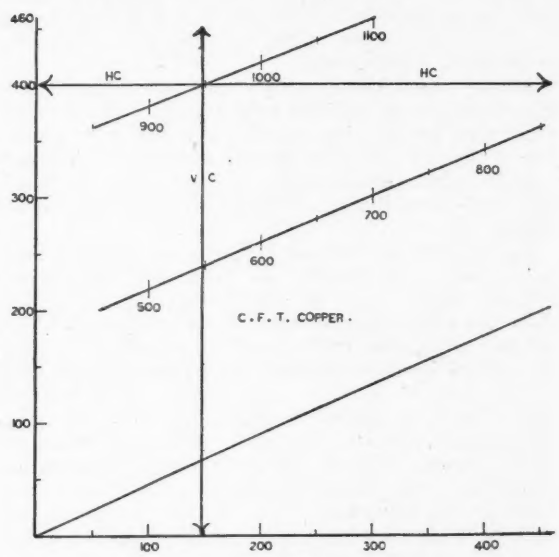


Fig. 20.

Example 11.—(Fig. 20.)

The copper conductor of a certain cable gave 3,125$^{\omega}$ at 35° F.

What would be equivalent resistance at 75° F. ?

75 — 35 = 40° F. difference in temperature.

Curve Sheet Scale Values for C.F.T. Copper.

Ordinate :—G_4 100 = 10° F. difference in temperature.

Abscissa :—g_3 100 = 0·01 (+ 1 = multiplying coefficient).

The curve for C.F.T. coefficient for copper has been plotted on so extended a scale—capable, that is, of so high a degree of accuracy, that, on the calculator board curve sheet, a difference of 20° F. brings the curve to the extreme limits of the board.

Higher up on the curve sheet the curve is therefore continued, and re-continued in a second, and a third linear continuation of the copper curve, the progressing hundreds and fifties being clearly marked at regular intervals along the curve, so as to form a continuation of abscissa scale g_4.

On g_4, as above stated	100 = 1·0100
	200 = 1·0200
	255 = 1·0255
	385 = 1·0385
(Limit of actual scale g_4)	460 = 1·0460
(On second portion of curve)	755 = 1·0755
(On third portion of curve)	950 = 1·0950
(" " ") ...	1,050 = 1·1050

To return, then, to Example 11, where it is a question of ascertaining the resistance at 75° F. of a conductor which gives 3,125$^{\omega}$ at 35° F.

Difference between the two temperatures being 40° F., bring H.C. to 400 = 40° on *omnibus* scale G_4.

To point where H.C. intersects curve for C.F.T. copper (in this case the third section of the curve) bring V.C., so that H.C., V.C. and curve, intersect each other at a common point.

At lower extremity of V.C. the multiplying coefficient 1·0147 is indicated, but the figures marked on the third portion of the copper curve intersected by H.C. show at a glance that the multiplying coefficient is not 1·0147, but 1·0947.

Then $3{,}125^{\omega}$ at 35° F. × 1·0947 = $3{,}421^{\omega}$ at 75° F. this multiplying operation being quickly effected by slide-rule.

Using C.F.T. tables for copper,

$$\begin{array}{rrrr} & \log & \log & \log \\ 3{,}125 :— & 3{\cdot}49485 & + \ 0{\cdot}03933 & = 3{\cdot}53418 \end{array}$$

$$= 3{,}421{\cdot}2^{\omega} \text{ at } 75° \text{ F.}$$

In a word, the curve sheet shows at a glance the multiplier or divisor for any correction of copper resistances for temperatures.

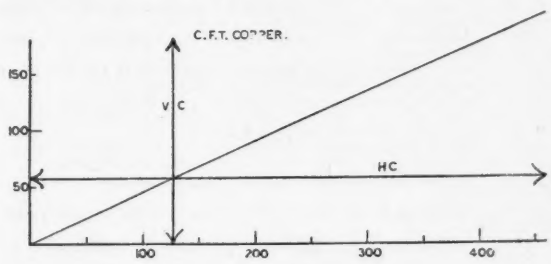


Fig. 22.

Example 13.—(Fig. 22.)

The observed CR of a cable lying in a ship's tank was 2,140·60 ohms.

The CR of the same cable, by factory values at 75° F., was 2,167·687 ohms.

Required to know the calculated temperature of the cable lying in the tank.

$$\text{By slide rule :—} \ \frac{2.167{\cdot}7}{2{,}140{\cdot}6} = 1{\cdot}0127.$$

Bring V.C. to 127 (= 1·0127) on scale g_3.

To point where V.C. intersects curve (this will be first section) for C.F.T. copper, bring H.C., so that V.C., H.C., and curve intersect at common point.

Then at left extremity of H.C. read, on omnibus scale G_4, 57.

Seeing that on this scale 100 = 10°, 57 = 5·7 = difference of temperature.

Therefore the temperature of the cable in the tank is 75° — 5·7° = 69·3° F.

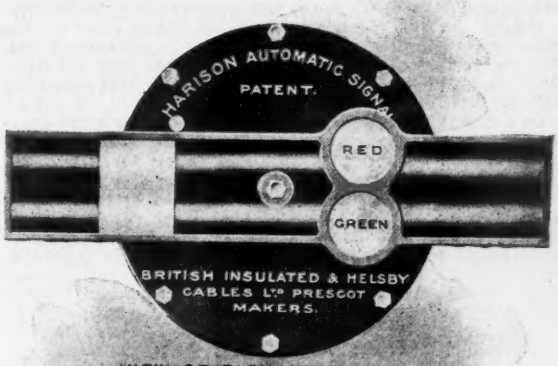
Let us again check by logs and tables the accuracy of the calculator board, though, of course, this is done only for the satisfaction of the reader.

	logs
CR at 75 = 2,167·687	3·33600
Obsd. CR = 2,140·600	3·33054
1·0127	= 0·00546 = 69·3° F.

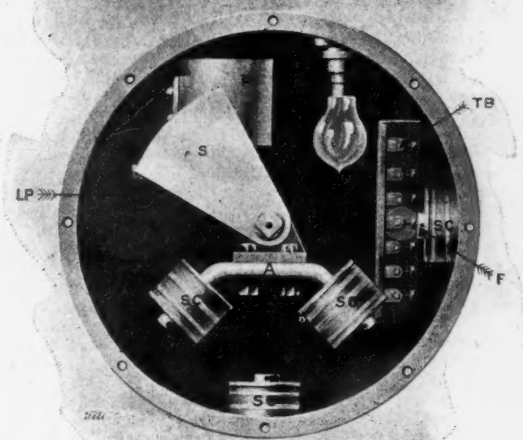
(*To be continued.*)

THE HARISON PATENT AUTOMATIC SIGNAL.

The extensive developments which have taken place in tramway work, since the advent of the trolley system, are naturally leading to a considerable proportion of single track being laid down in districts where the traffic does not justify a double track. For working the traffic on routes of this description, a system of automatic signalling is an absolute necessity, if schedule times are to be maintained. Where stopping places are out of sight of each other, delays frequently occur through the over-running of the turnouts and the meeting of two cars travelling in opposite directions on single lines. Fogs and breakdowns also delay traffic, owing to the uncertainty of procedure which prevails when cars do not meet at the appointed time and place.



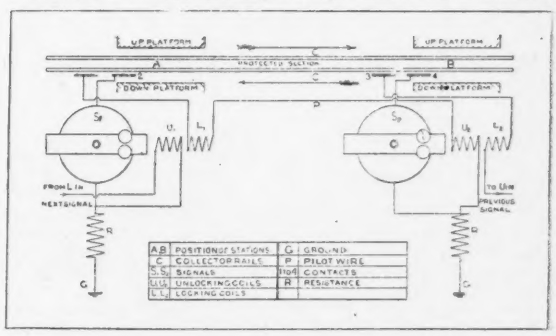
VIEW OF SIGNAL WITH ARM AND LID IN POSITION



VIEW OF SIGNAL WITH ARM AND LID REMOVED SHEWING POSITION OF MECHANISM WHEN ARM IS AT DANGER

S C, Signal coils; A, Armature; F, Fixed pole-pieces; L P, Locking plunger; S, Shield; L, Locking solenoid; P, Preference solenoid; T B, Terminal board.

Diagram of Shunt System; Double Line Tube Railway.



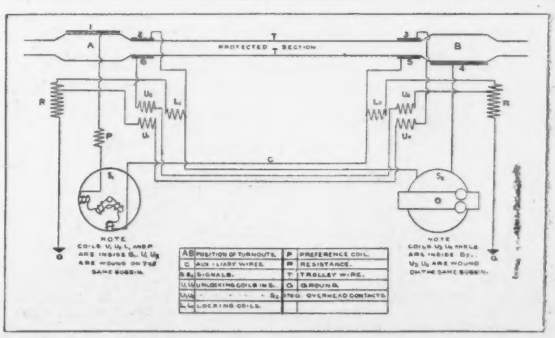


Diagram of Shunt System; Single Line and Turnouts.

The Harison system is automatic and simple. It is arranged on the lock and block principle; only one car or train is allowed on the protected section at the same time. It also provides

for the contingency of two cars entering the protected section simultaneously from opposite ends, a most important feature, which has frequently been overlooked. The Harison signal is also specially designed for use on double-line tramways and tube railways, where cars and trains run in one direction only on the line, in fact, it can be adapted to nearly any conditions of working.

The signals consist of miniature railway semaphores, with red and green spectacles, illuminated at night by incandescent lamps. The semaphore arm is weighted so as to return from the "line clear" position to "danger" entirely by gravity, thus complying with the Board of Trade regulations.

On a current being passed through the signal coils S C, the armature A carrying the semaphore arm is attracted by the fixed-pole pieces, F, thereby lowering the arm to the "safety" or "line clear" position. The arrangement for locking the arm at the "danger" position, and unlocking the same, is accomplished by two solenoids provided with a common plunger, L P. When current is passed through the front or locking solenoid L, the plunger is drawn into it and engages with the "shield" S on the shaft carrying the arm, thereby preventing it from lowering. When a current is allowed to pass through the rear or unlocking solenoid, the plunger is drawn back into it and disengages from the shield, and the arm is left free to lower. The preference solenoid P is provided in one only of the two signals protecting a section.

This is a device for preventing the preference signal from being locked, and comes into action when two cars are trying to enter the protected section at opposite ends at the same instant. It has no effect if the preference signal is already locked. The mechanism of the signal proper is, therefore, extremely simple, there being no electrical contacts to wear, spark, or get out of order, so that the maintenance is practically nil. The whole of the working parts are enclosed in a cast-iron watertight case, with a small door in the lid for inspection purposes.

The installation can be carried either on the shunt or series system, both being applicable to double and single trolley lines, while the shunt is best suited to underground third rail lines.

Diagrams of connections are shown for the shunt system arranged for (1) a single line and turnouts; (2) a double line tube railway. In the first case six overhead contacts are erected, shown at 1, 2, 3, 4, 5 and 6; contacts 1 and 4 are arranged so that a car always stops underneath them while waiting on the turnout; the remaining contacts being placed so that there is no possibility of a car stopping underneath them. Suppose a car arrives at A and makes contact with 1, the circuit P, S_1 and L_2 to earth is completed. If this line is clear S_1 is lowered and S_2 is locked. The car then proceeds to 2 where the circuit made is L_1 to earth, thereby locking S_1 behind it, the line being now blocked.

When the car arrives at 3 the circuit U_4, U_1 to earth is made, and both signals are unlocked. The operations of 4, 5 and 6 contacts are identical with numbers 1, 2 and 3 respectively. It will be noted that 3 and 6 are provided with separate unlocking circuits which can never be alive at the same time.

The windings of the solenoids are so arranged that (1) if U_1 and L_1 are both energised S_1 remains unlocked; (2), if U_2 and L_1 are both energised S_1 is unlocked; (3), if U_3 and L_2 are both energised S_2 remains locked; (4), if U_4 and L_2 are both energised S_2 is unlocked. Also if L_1 and L_2 are dead U_1, U_2, U_3 and U_4 are each of themselves capable of unlocking their respective signals.

Bearing these facts in mind the following cases are taken to show the action of the signal:—(1) If car A reaches 1 before car B reaches 4, S_1 is lowered and S_2 locked, or *vice versâ*. (2) If cars A and B arrive at 1 and 4 simultaneously, S_2 is locked, but not S_1, since the preference coil prevents it, car A thereby having the preference. (3) If cars A and B are waiting at 1 and 4 respectively, and a third car C is on the protected section, the signal at which it arrives will be unlocked, but not the one behind it.

In the second case of the shunt system applied to double-line underground tube railways, suppose a block to comprise the distance between two stations, *e.g*, A and B. A train arrives at station "B" and makes contact with B_4, thereby establishing a circuit through S_2 to earth. The signal arm of S_2 (presumed to be unlocked) is lowered, and the train proceeds, allowing S_2 to return to danger. The train then reaches B_3, causing current to flow through L_2 and U in the signal behind to earth. S_2 is therefore locked and the last signal unlocked.

The arrival of the train at station "A" on A_2 contact, causes S_1 to lower if unlocked. The cycle of operations is then repeated at A_1 where S_1 is locked and S_2 is unlocked, thus ensuring that no train can leave station "B" until a train on any portion of the line between B_3 and A_1 has left station "A" and locked signal S_1.

The attention of tube engineers is specially called to this very simple but reliable and safe arrangement of working, and also to the fact that the mechanism of the signal complies entirely with the Board of Trade regulations.

NEW PATENTS APPLIED FOR, 1903.

Compiled expressly for this Journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

21,858. "Improvements in electrical switches." J. A. K. McGregor and H. Wren. October 12th.

21,866. "The dome sparking plug." J. Healey and O. H. White. October 12th.

21,875. "Improvements in trolley heads for electrically-driven vehicles." G. Varley. October 12th.

21,882. "A new combination of motor and gearing for electric hoists and cranes." W. L. King. October 12th.

21,885. "Improvements in or connected with the manufacture of electric lamps." L. H. Walter. October 12th.

21,898. "Means for operating valves, cocks, taps, electric switches and the like at predetermined intervals." W. P. Miles. October 12th.

21,909. "Improvements in and relating to electric arc lamps." G. M. Lane and E. H. Adams. October 12th. (Complete.)

21,921. "Improvements in and relating to electrical fire arms." W. Kron. October 12th.

21,980. "Improvements in or relating to means for preventing the fusing and flaring of electric wires carrying electric lights." M. McDermott. October 12th.

21,963. "Improvements in wireless telegraphy." J. H. Lee. October 12th.

21,972. "Improvements in dynamo-electric machinery." J. H. St. Hill Mawdsley. October 12th.

21,980. "Improvements in and relating to electric arc lamps." R. Hulsart and E. H. Adams. October 12th. (Complete.)

21,983. "An improved trolley head for electric traction wires." J. J. Carter. October 13th.

21,984. "Improvements in starting switches for electric motors." T. E. Weaver. October 13th.

21,987. "Improvements in clockwork electrical stopping and starting apparatus." F. Mitchell. October 13th.

21,996. "Improvements in electromotor starters." C. J. Casse and H. H. Casse. October 13th.

22,008. "Improvements in multipolar electric generators and motors." T. L. Boyden. October 13th.

22,013. "An improved electric heater or radiator." E. G. Rivers. October 13th.

22,016. "Electrical circuit-breaker." J. B. Tannahill. October 13th.

22,053. "Improvements in and relating to dynamo-electric machines." W. C. Martin, J. Lowson, and W. B. Sayers. October 13th.

22,087. "An apparatus for establishing electrical correspondence." L. Despradels. October 13th. (Complete.)

22,090. "Improvements in the manufacture of electrodes and resistances." G. Cornaro. October 13th.

22,097. "Improvements in or in connection with trolley or like current collectors for electric traction." A. B. Upham. October 13th.

22,101. "Improvements in circuit-breakers." T. E. Daniels, jun. (Date applied for under Patents Act, 1901, January 2nd, 1903, being date of application in United States.) October 13th. (Complete.)

22,181. "Improved means applicable for use in transforming alternating currents." G. G. M. Hardingham. (L. Magrini, Italy.) October 14th.

22,182. "Improvements in electrical switching apparatus." J. R. Dick. October 14th.

22,210. "Rectifying transformer for alternating currents." P. Dewhirst. October 15th.

22,216. "Improvements in laying electric conductors." A. E. Tanner and E. A. Claremont. October 15th.

22,185. "Improvements in the manufacture of insulating material." J. B. Alexander. October 14th.

22,269. "Improvements in or relating to brushes for electrical machines." G. M. Gibson. October 15th.

22,287. "Improvements in electric arc lamps." W. J. Davy. October 15th.

22,291. "Improvements in electric generating machines and motors for continuous current." J. W. P. Scott, J. Coghlan and E. S. Moulden. October 15th.

22,324. "A new or improved machine for developing electro-motive force." J. H. Cox. October 16th.

22,356. "Improvements in apparatus for use in the electro-deposition of metals." S. Cowper-Coles. October 16th.

22,365. "Improvements in electro-magnets." W. Baxter, jun. (Date applied for under Patents, Act, 1901, November 21st, 1902, being date of application in United States.) October 16th. (Complete.)

22,371. "Improvements in overhead trolleys or collectors for electric tramway and railway vehicles." T. Blaney. October 16th.

22,388. "Improvements in apparatus for enabling telephonic and telegraphic messages to be transmitted over the same line wire." F. W. Howorth. (C. Turchi and E. Brunè, Italy.) October 16th. (Complete.)

22,423. "Improvements relating to electric generators and motors." J. H. Hindle. October 17th.

22,432. "Improvements in electrical ceiling fittings." C. M. Dorman and R. A. Smith. October 17th. (Complete.)

22,439. "An improved electrical connection for electro-chemical apparatus." F. J. Turquand and J. F. Wakelin. October 17th.

22,443 "An improved apparatus for winding inductive and non-inductive coils." W. H. Wilson. October 17th.

22 465. "Improvements in safety devices for alternating current electric distribution systems." The British Thomson-Houston Co., Ltd., R. C. Clinker, E. B. Wedmore and J. Whitcher. October 17th.

22,470. "Improvements in turnover or alternative switches for electric currents, especially for lighting purposes." R. S. Pilcher. October 17th.

22,475. "An improvement in collecting electric currents from armatures of unipolar dynamo-electric machines." F. E. Elmore. October 17th.

22,486. "Improvements in electrical range finders." H. Shoemaker. (Date applied for under Patents Act, 1901, January 10th, 1903, being date of application in United States.) October 17th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1903.

8,329. "Improvements in electric accumulators." R. Trub & Co., Ltd. (Date applied for under Patents Act, 1901, April 19th, 1902, being date of application in Switzerland.) Dated April 11th.

8,321. "Improvements in and relating to safety devices, applicable to electric cars and the like." M. Heinrich, E. Heinrich and R. Proeger. Dated April 9th.

8,322. "Improvements relating to motor-ampere-hour meters for various electric pressures." W. E. Evans. (Allgemeine Elektricitäts Gesellschaft, Germany.) Dated April 9th.

8,480. "Improvements in electric heaters." J. E. Dube. Dated April 14th.

8,497. "Improvements in and relating to electric dynamos and motors with alternating field." R. Ziegenberg. Dated April 14th.

8,512. "Improvements in electric arc lamps." F. W. Gore. Dated April 14th.

8,584. "Improvements in or relating to electtic signalling apparatus for railways." A. Oesterreicher and L. Nemelka. Dated April 15th.

8,658. "Improvements in and relating to electrical transformers." H. Loewenstein and H. Loewenstein. Dated April 16th.

9,664. "Improvements in systems of electrical signalling for railroads." C. Barber. Dated April 16th.